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"Comparative Analysis of Military and Commercial Logistics: Present and Future Possibilities for the Transfer of Principles and Practices."

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ABSTRACT

Throughout time, comparisons have always been made between the management of the public and private sectors (nowadays the voluntary sector too, is included in these comparisons). However, the management of the defence element within the public sector, has generally been considered so diverse from private enterprise, that it escaped rigorous academic attention until about the beginning of this century. Considered even less attractive to academic research, has been the comparison of defence logistics to commercial logistics, the latter being very young, when compared to the former. Defence/military logistics has been developing, in its practical sense, ever since one tribe/community had a fracas with a neighbouring tribe/community, through continental conflicts between states/nations, to intercontinental wars. Although serious academic attention has been paid to commercial logistics for about the last 40 years, the *theory* of it is very much in its infancy and is still being developed. The time has come for the logistics in these two sectors to share their knowledge/'know how', so that the learning of each sector is not lost, but transferred, if applicable, to the mutual benefit of each.

From an inquiring exploratory comparison of the logistics in both the defence and business sectors, this thesis builds a foundation that branches out to a secondary research, which is the historical evolution of the two, and it discovers that they both followed the same evolutionary stages/patterns in their developments, but at different times, and, in general, they have a pattern of convergence. In 1970, Rider developed a tabulated comparative model of the two logistics from his research question "What is logistics?" Whilst Rider found some differences between military and business logistics, this thesis revisits and re-examines his table in the light of modern day data, and finds that the two logistics have converged further since his research. For the core research of this thesis, two hypotheses were generated: (i) a research null hypothesis of "there is no fundamental difference between military and commercial logistics"; and (ii) from the literature searches/surveys and the historical evolution work, a constructed quadramorphic 'types of logistics' model formed the platform for a predictive hypothesis that "the logistics in the two sectors use all the four types contained in the model". The methodology chosen for the primary research was the analysis of qualitative data collected mainly via case studies (a focus group and a Delphi approach were used too); 17 case studies in all were conducted. The outcome is that the two hypotheses are accepted, the first one with the proviso/caveat of "excluding rules of priority, mobile nodes, lack of electronic connectivity, and some designed-in inefficiencies", as these were found to be prevalent only within the military.

Another finding that proved noteworthy is the fact that both logistics, naturally, have the same variables, but the importance attached to the variables differs for each sector and for within different time periods. Here again, evidence of convergence, significantly in the latter years, was discovered, particularly in association with: reducing costs; time

compression; tracking and traceability; availability; relationships; and the provision of service(s). One aspect that distinguished the two sectors was the fact that business uses much more computerisation and electronic data capture/collection and transmission, it functions via its *connectivity*; whereas the military - having more of a vertical integrated structure working through soldiers and their teamwork - functions via its *contactivity*.

Two principal methodologies were employed in this research: the primary research used mainly *live* qualitative data collected chiefly by case studies; and the secondary research again used mainly qualitative data gathered from secondary sources via historiography. The outcome of the analyses of the two research types tended to confirm each other with a good degree of compatibility and agreement.

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The other component of this work, the businesses and commercial enterprises that allowed their situations to form case studies for me, I am indebted to you all, and assure those of you, where it is relevant, of the confidentiality to which I agreed. I thank all the companies for letting me visit, ask questions, see documentation and conduct interviews; again I have gained much knowledge from these encounters.

Librarians tend never to be mentioned. In the compilation of this thesis, I have had to visit/use many libraries. I am grateful to all the librarians that helped me to find those awkward, old and unknown books, literature and documents.

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Finally, I dedicate this thesis to my parents Waclaw and Caterina (nee Errico) Ostrowski who sacrificed so much to enable my siblings and myself to obtain a good formal education - the value of which was understood by both my parents, but unfortunately they were deprived of it themselves, because of the advent of WW2.

Silverio L. Ostrowski.

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1. INTRODUCTION

"Studies, serve for delight, for ornament, and for ability."
Sir Francis Bacon (1561-1626)

1.1 Background

The ever changing and dynamic world that exists today invites constant questioning of the way we do things, and of how we should structure ourselves to achieve the satisfactory matching of products and services to meet the new demands being made. Particularly, this applies from a business perspective to the challenge of becoming, or remaining competitive and profitable. Likewise, this applies in the public sector, for as political complexions and world order transpose, governments have to provide the services and climate to stimulate the economy and ensure a reasonable standard of living within the balance of their revenues.

One of the services a government can provide is national defence and this generally constitutes a large proportion of government spending (e.g. for the UK 17.44% of the total Civil Supply in 1972-73 and 11.20% of general government expenditure in 1990-91 (this peaked in 1984-85 at 13.0%)) and as such can be a significant part of a country's Gross Domestic Product (GDP) (e.g. for the UK 6.50% of GDP in 1970 and 4.52% in 1990-91). In absolute terms, the total expenditure for the UK Ministry of Defence (MoD) for the fiscal year 1994-1995 was £23.80 billion and for the current period 1998-1999 it is £22.24 billion; see Extract 1.1 for more details and comparisons.

Although Von Clausewitz (1843) postulated: "War is nothing but a continuation of politics with the admixture of other means." the purpose of a defence force (see the Defence White Paper) is fourfold:-

1) to assist it's Foreign Office in any international negotiations/persuasions, (e.g. like a *demarche*);
2) to provide, and/or act as a deterrent to other nations or would be aggressors;
3) to fulfil any of the military role commitments on behalf of, or owing to NATO, United Nations or any other international body/agency; and
4) to beat the enemy, if engaged in a war or conflict.

With the 'iron curtain' now drawn-back (and hopefully tied-back forever), most western nations have a window of opportunity opened to them to review and restructure their defence profile. A defence profile can be described as having two principal components: the 'teeth arm' which does the fighting, i.e. the front-line; and the 'tail' which supports the front-line in its fighting by feeding forward the necessary consumables and materiel[1] that it requires, i.e. the logistics support. One way the military

[1] Materiel: military equipment in its widest sense including vehicles, weapons, ammunition, fuel, etc.

Funding hits Service morale

By Tim Butcher, Defence Correspondent

MASSIVE fluctuations in defence spending over the past few years are revealed in the latest Ministry of Defence figures, even though Labour and Tory politicians had promised a period of stability.

Described by one senior officer as a "financial roller-coaster", this instability is believed to be harming morale across the Services.

With the defence budget standing at £22·2 billion, the MoD figures show a cut of seven per cent in real terms in 1995, an increase of 0·9 per cent in 1996, a cut of 4·8 per cent in 1997 and a planned cut of one per cent this year. "We were promised a level playing field after the cuts of the early 1990s but the cuts still keep coming," one officer said. "No wonder people think twice about a Service career."

The instability in defence is made worse by uncertainty over the outcome of the Strategic Defence Review, which is not expected to end until the review's findings are published in a Defence White Paper this summer.

The figures in the 1998/99 Defence Expenditure Plans confirm an earlier *Daily Telegraph* report that defence spending between 1996/97 and 1997/98 was substantially cut. The tables reveal the cut to be 4·8 per cent. While the overall trend on spending continues to be down, the figures reveal a rise this year in money due to be provided for defence by the Treasury of more than five per cent in cash terms.

This is because the Treasury is expected this year to maintain defence payments that last year were covered by part of the MoD's windfall from the £1·66 billion sale of the married quarters estate.

The MoD will receive £22,240 million this year from the Treasury in comparison to £21,135 million last year, a 2·25 per cent rise in real terms.

(Source: *The Daily Telegraph*, Tuesday, 21st April 1998, page 8)

Extract 1.1 Funding Hits Service Morale

defines logistics is as *"the time related positioning of resources"*. The UK government has suggested that the defence profile it would like is one where the current front-line strength and capabilities are unchanged, but where the total cost of defence is significantly reduced[2]. Given that the teeth-arm is generally fixed (some minor cost savings can be made here by combining Regiments and/or Services), then it appears that the bulk of defence cost reduction would have to come from the caudate segment. In 1994, 16% of the British Army's headcount was in the Royal Logistics Corps (RLC). This poses the question: how can defence/military logistics costs be reduced substantially but still proffer the same, or better, service/support levels?

Also, from April 1985, Crown Immunity for the UK defence forces was rescinded. This meant that the defence forces had to comply with any existing (and will have to comply with any future) legislation appertaining to the general logistics, storing, handling and transportation of sustaining themselves. This prompted many changes as various new problems had to be overcome. For example, where in the past a military driver could drive as many hours as was warranted without a break or rest period, the removal of Crown Immunity meant that all the laws concerning health and safety of drivers had to be complied with. Thereby, all military management of transport fleets and drivers were subjected to the same rules and regulations as commercial operators.

Possessing Crown Immunity had many advantages, but with its removal came the option of outsourcing or third party involvement, as the 'rules of the game' were, more or less, equalised and, of course, benchmarking became possible, because in general, 'like for like' situations were now commonplace (although true 'like for like' is not totally 100%; one example is that the military Green Goddess vehicles do not have tachometers and/or tachographs fitted).

An immediate solution, or offered response, might be to transfer some of the commercial/business logistics principles and practices into the military caudation. After all, for the past 35-40 years one of the principal aims of industry has been to reduce the cost(s) of material and product supply and distribution (i.e. logistics). Also, in the past, like a hundred years ago, many military operations - and their logistics - were of a vast scale or magnitude, much larger than any commercial enterprise. Today, with the advent of large experienced multi-national companies and globalisation (i.e. world markets being treated as a 'global village'), coupled with the volatile demands made by the markets, the tables are probably turned; many commercial enterprise operations and, hence their logistics, are on the same scale, if not larger, than some national defence forces. Superficially, this transfer may seem reasonable, but how applicable is this suggestion? To be able to answer the question in a comprehensive manner requires a comparative

[2] "Front Line First", Malcolm Rifkind, Secretary of State for Defence, Statement to the House of Commons, UK, 14th. July 1994

study or analysis of military and business logistics to see whether the appropriate commercial logistics principles and practices could be transferred and implemented within the military context. The assumption should not be made that the transfer will be one-way only; it is possible that the military logistics *modus operandi* may have something to offer the business sector, thus providing a two-way flow and exchange of ideas, principles, tenets, processes, practices and mutual benefits.

An example of successful transfer of knowledge/'know-how' from military to the civilian domain is the Boeing 747 (Jumbo) aircraft. The Boeing 747 aircraft was developed mainly by the US Department of Defense (DoD) sponsorship for an air mass transportation means after the failure of the C5A Galaxy by Lockheed. Whilst the 'Jumbo' is used widely by the US military (and the space programme) in various guises/models/types, it has become the world's best-selling commercial aircraft to-date, constituting the largest proportion of the inter-continental fleet. If such exchanges between the commercial and defence sectors do not continue, then the LEARNING will be lost, due to its non transference. The transference of logistics tenets, precepts and canons is no different; where elegant solutions have been effected in one sector, then it should be applicable within the other sector, provided there is no fundamental difference in the two logistics.

1.2 UK Defence Review

Recently (1997-1998) the UK government conducted a Strategic Defence Review (SDR) and the outcome was a set of proposals to both cut the defence budget substantially and restructure the defence forces to provide a better matched defence capability (given the new order of the world) for the same cost or less. This can be achieved by shifting resources to where they are *really* needed - with no increase in the budget - and/or eliminating aspects considered not necessary now. Particularly being reduced are: the British tank Regiments in Germany (presumably from six to four Regiments only); (in all, Britain's total eight tank Regiments will be changed into six larger tank Regiments, each with 58 tanks (they will use only 30 tanks each in peacetime training)); the Territorial Army (TA) (with numbers to be reduced from 56 000 to 40 000 soldiers); and some Royal Air Force (RAF) maritime strike Tornado squadrons (including the famous 617 Dambuster squadron). By reducing or eliminating 36 combat aircraft of the RAF's maritime strike role (there are about five other different ways of sinking ships these days, like submarines firing Harpoon anti-ship missiles, by ships and by other RAF aircraft), the RAF could gain circa 26 front-line Tornadoes and their crews to reinforce squadrons earmarked for high-readiness joint-service operations. Further savings are to be had from the Royal Navy (RN) via the intention of having two fewer submarines and three fewer destroyers and frigates. There will be major changes in *readiness* status - the time a unit needs to go to war from a standing start. Many units,

doing what are considered "Cold War" jobs, will have their readiness downgraded. The reductions in the readiness of these front-line units, by placing them on lower alert, or disbanding them altogether, will release resources for other roles/duties and, funds - part of which will pay for highly-mobile 'expeditionary' forces and perhaps more digital technology.

Other units like *quick reaction forces* will be placed at a higher state/level of readiness as part of a much-expanded 'expeditionary' force (like a *Rapid Reaction Corps*), able to travel at very short notice to any global trouble spot to engage in '*conflict prevention* and/or *defence diplomacy, peace support* and *humanitarian*'[3] operations. Such a Reaction Corps will be equipped with four large heavy duty transport aircraft, like the McDonnell-Douglas C-17 *Globemaster III* or the C-130J *Hercules* (the advanced multi-role transport aircraft) or their equivalent, capable of carrying/taking armoured vehicles - this is one of the most glaring gaps in Britain's current arsenal. Although Britain already has a mobile rapid-reaction unit - the Joint Rapid Deployment Force (JRDF) - it does not possess planes capable of carrying its equipment. Ostensibly, the 28.6% reduction in the TA infantry is because they are becoming a "pool" of *specialist expertise*, which the Regulars can *dip-into* for their needs, rather than a full reserve army in its own right (this option is politically sensitive as ministers are conscious of the TA's role in "bridge-building" with the wider community and therefore they may not fully approve of this concept). However, the Regular Army will be allowed to recruit a further 3 300 soldiers.

Costs can be saved by merging units and/or joining-Services too - via their associated rationalisation and ending the duplications which exist. Plans are afoot to merge the RAF, RN and the Army's helicopter operations. The RAF provide *support* and *rescue* helicopters, the RN *sea transfer* helicopters and the Army, *attack* helicopters. The creation of a joint battlefield helicopter group under a single command has been announced, using officers from all three Services to run it, thus avoiding disputes over/about ownership. As the RAF and RN both operate Harrier jump-jets, combining these units makes sense; indeed in the past the RAF have already flown these aircraft from aircraft carriers - which is usually the RN's domain for operating such aircraft. Interestingly, the Paratroop Regiment (the 'Paras') have not been deployed operationally as parachutists since the Suez Crisis in 1956; so, should this Regiment be disbanded? No; it will be incorporated/merged into/with the new tri-Service helicopter group/squadron.

The total military inventories (consumables, clothing, spares and pool and replacement equipment) owned by the MoD is valued at around £10 billion and the annual cost for their holding, storage, conservation and preservation is circa £50 million. Some of these items purchased 80 years, or so, ago (like just after WW1) may never be used or

3 Terms used by George Robertson, Secretary of State for Defence, in his statement "Modern Forces for the Modern World" to the House of Commons, UK, 8th. July 1998

needed again. Some scope exists here too, for a rationalisation and re-think which could realise some savings of the order of £2.2 billion (i.e. circa a 20% reduction in stock holding).

Part of the money saved from these changes will be used to enhance logistics capabilities like getting: the four heavy lift military transport aircraft (as stated above); air refuelling tankers; and the acquisition of four additional 'roll-on, roll-off' (Ro-Ro) military container ships; as well as investing in the growth area of "battlefield digitisation" - the computerisation of warfare in which the speed, analysis and distribution of accurate information is considered equally, or even more important than the application of combat power. The US has already invested massively in this field, far outpacing Britain. With their satellite intelligence-gathering, unmanned reconnaissance drones, JSTARS battlefield-watching planes and radio data links direct to planes, ships and ground units, the Americans are increasingly able to determine the enemy's intentions and deploy *information warfare* to disrupt it, or manoeuvre friendly forces to stop/prevent it in the most efficient manner, i.e. logistically as well as speedily and politically. They are also researching ways of sending computer viruses and electrical spikes to wreck enemy systems and power grids. There is serious concern at the Ministry of Defence (MoD) that unless Britain follows suit in at least some of these areas, it will be unable to 'stay in the game' and its role as an ally will be reduced to one of providing the 'foot soldiers' and taking/incurring the casualties in a digitally-ordered war run entirely by the US. High technology can be a 'force multiplier', which initially costs money but can also save money because it would result in greater power coming from fewer (and possibly leaner) forces. The MoD has constantly been accused of refighting the last war in their reviews; perhaps now they can get away from the Cold War and fight the next (i.e. 21st century) one.

There has been a recognition that some commercial practices/principles could help the military reduce costs and provide/deliver the same *outputs*; after all, the same language is now being used: George Robertson[4] said that cost reductions/savings by mlitary (and associated) personnel at MoD "... will do this primarily through increased efficiency, smarter procurement and better utilisation of our assets." Such quantum changes as revealed in the SDR and outlined above require properly planned and organised change management policies, principles, processes and practices. It is unlikely to be easy: the very notion of combining all three Services, each with its own history, traditions, cultures and individual *modus operandi*, into one *defence force* may be considered heresy by some who fear reductions in promotion prospects as a result of the removal of cost consuming internal *little empires* that have been built-up throughout history. The final structure of the defence force(s) that emerged from the review will need to be supported

4 "Modern Forces for the Modern World", George Robertson, Secretary of State for Defence, Statement to the House of Commons, UK, 8th. July 1998

and sustained by a new logistics structure compatible with, and capable of meeting, the demands made. Therefore, a corresponding logistics support review was inherent in the defence review and an appointment of a 'four star' Chief of Defence Logistics (CDL) with a budget of £5.5 billion (excluding the Procurement Executive (PE)) was made who will coordinate and standardise the three support services *properly* for the first time. Notice that the CDL's budget is 25% of the MoD budget, which is an indication of the *power* he will hold; if he had the PE as well, he would have been the largest budget holder in the MoD. Whilst it would have made sense to put the PE within the CDL's domain - after all, purchasing is part of logistics in today's parlance - perhaps it was not structured that way in order to curtail the CDL's *power*? The PE itself is to strive for more efficient practices by following the procedures of a 'Smart Procurement Initiative' (SPI).

Increasingly, military operations will become more integrated and take a joint Service approach. Experiences from the Falklands 1982 and the Gulf 1991 skirmishes revealed that the UK defence capability could only handle one such magnitude operation at a time. Indeed, one army officer told the author: "If the Russians had decided to attack us during the Gulf crisis, they could have walked-in and taken us without a scrap. There was no hardware left in the country - or Germany for that matter - of any consequence." Whilst the proposed restructuring will help considerably towards enabling the UK defence forces to carry out more than one Bosnia type operation at a time (i.e. it is essential to be able to support two lines of communications - probably at Brigade level), it cannot achieve this by only *cuts and slashes* - some spending and modernisation will be necessary too. To that end, two new large and versatile aircraft carriers will be built/purchased. Aircraft carriers provide floating mobile off-shore *islands* which offer tremendous flexibility and avoid the need of politically sensitive approaches to nations/states/countries for permission to use *their* land bases, resources and support (i.e. avoiding the need for *host nation support*). Also, the RN will move away from a policy of *open sea* defence strategies towards a *land/coast hugging* and littoral defence policy/strategy. In addition, the MoD has committed itself to buying 232 EuroFighters (*Typhoons*) for the RAF as well. All this new capital and technological equipment and the Service personnel involved, will need to be logistically sustained, supported and serviced. As George Robertson (MoD, 1998) said: "As a result, our forces will be more mobile, better manned, better supported and equipped and better able to act as a force ..."

On the human resource side, George Robertson also stated: "... and all personnel will be given the chance to achieve qualifications recognised by civil employers." This means that military people who take this opportunity will be exposed to the commercial ways/manners/ideas in the process of gaining those qualifications and will thus be able to make comparisons, and hence applicable suggestions, that are compatible with changes and improvements within the military context.

1.2.1 The Implications Of Moving Towards A Commercial Model

The SDR identified that there was scope for reshaping the way MoD conducts its total logistics, particularly with respect to the further outsourcing of the acquisition of routine items (e.g. IT catalogue, general stores) and specific functions. Indeed, the SDR pointedly stated (MoD, 1998:25) that the use of contractors to augment or relieve military logistic forces will be considered (the author envisages a growth in this area, i.e. 'outsourcing'). However, for complex projects, the MoD, like other organisations that manage large projects, needs to keep core management in-house, whilst buying/hiring *specific skills*. The Procurement Executive (PE) is to employ commercial principles/practices of customer-supplier relationships within its operations by the use of Integrated Project Teams. When these *teams* are formed, they will have a customer-supplier relationship with a *Central Customer*, who will define the high-level mission need.

Part of the Smart Procurement Initiative (SPI) encompasses the move to a new partnering arrangement with industry. The need was identified and recognised that to resolve problems, working closely with industry was required and so ***partnership*** is a key theme. Also, having realised that one organisational structure/arrangement does not cover/work efficiently and effectively for all scenarios, it was seen that some tailoring would be necessary. One way to enable the streamlining of processes and the tailoring of them to different types of acquisition, was the creation of three tiers, as follows:-

Tier 1: For smaller items and in-service support, good commercial practice will be followed by streamlining, using credit cards or cash for minor purchases. Industry will be relied upon a lot more for support; in some cases the complete operation might be outsourced.

Tier 2: For smaller projects there will be a single integrated team approach including industry, and much will be done to make systems more flexible and less paper-driven with fewer reviews by Committees and more authority devolved to the team leader.

Tier 3: For major projects (including collaboration) the integrated team approach will be used.

With regard to ***ownership*** of the PE - various options were considered. It was regarded as essential to achieve greater clarity in customer/supplier relationships within the rest of MoD, and greater flexibility in personnel matters, whilst at the same time not reducing the scope for interchanges with the rest of MoD. So, to privatise, or just move towards agency status?

Privatisation - whilst giving greater access to private sector expertise and incentives, this was not seen as a feasible option for an organisation that needs to be close to its military customers, and which brings together a wide range of interests through the Single Team Concept. Two cogent issues that emerged from the considerations were:-

(i) The PE already has many of the technical features of an agency and could change status

quickly. A key issue was whether the relationship between Ministers reflected in the 'Framework Document' could cover all of the complex factors that can affect an individual equipment decision as well as obtain value-for-money (VFM); and
(ii) Interestingly, Industry saw procurement as an in-house function for MoD.

From all the above, British Government Ministers concluded that the PE should move to agency status in 1999 - hopefully by April 1999. Also, from April 1999, the 'Defence Storage and Distribution' and 'Defence Transport and Movements' tri-Service Agencies have been formed. These follow the success of the tri-Service defence 'Medical Supplies Agency' (MSA). The debates about the privatisation of these Agencies continues.

1.3 Aims Of The Thesis

From the above, the timing could not be riper for this work/thesis and the intention is to conduct a definitive comparison between military and commercial logistics, in particular quick (or rapid) response logistics: to seek pattern matches; and to highlight principles, techniques and methodologies that are inter-changeable (similarities) and those that may not be inter-changeable (differences). The purpose of the thesis and, thus its aim, is threefold:-

(i) to advance the knowledge and theory of logistics by drawing on the experiences of both sectors;
(ii) to discover the similarities and differences of the two logistics sectors, primarily in supply; and,
(iii) to institute a platform for, and to promote the exchange of logistics ideas, principles, tenets, canons, practices and logic between the two sectors for their mutual benefit.

From the stated aims it may be possible to make a contribution to the development of a generic strategic logistics planning model for the design of military and commercial logistics management in the 21st century. Furthermore, a basis (or platform) could be provided that will encourage dialogue and exchange between military and non-military personnel for the advancement and retention of logistics knowledge. Such is the *mise en scene* for this thesis. What follows is a comparative study/analysis of business and military logistics (mainly in the guise of the UK Army).

1.3.1 Adopted Approach

In order to pursue this research, and to ensure validity in its outcome, the approach adopted was along the lines of the steps shown in Table 1.1. In the first instance, an exploratory undertaking was pursued via a basic *grounded theory* entry to discover the magnitude and boundaries of the subject matter. During this exploratory phase, it became evident from the personal contacts made by the author, that obtaining 'live data' for this

Exploratory: *Basic* Grounded Theory Approach
(Chapter 2)

↓

Historical: The Evolutionary Development of Both Military and Commercial/Business Logistics
(Chapters 3 and 4)

↓

Theory: Pertinent Theoretical Aspects for the Two Sectors' Logistics
(Chapter 5)

↓

Specific: Quick/Rapid (Efficient Consumer) Response Logistics
(Chapter 6)

↓

Variables: The Principal Variables of Logistics
(Chapter 7)

↓

Hypotheses Development:-
(i) A Qualitative Null Hypothesis of No Fundamental Difference Between the Two Logistics
and
(ii) A 'Types of Logistics' Matrix/Model
(Chapters 8 and 9)

↓

Research Design: Grounded Theory Analysis of Qualitative Data Gathered Mainly via Case Studies
(Chapters 9 and 10)

↓

Analyses, Discussion and Conclusions
(Chapters 11 and 12)

Table 1.1 Route Map of the Thesis

research would be difficult: from a security/access standpoint with the military; and from a commercial confidentiality/access viewpoint for the business sector. Therefore, as a contingency measure which also acted as a secondary methodology for confirmatory purposes, and to further comprehend the stimuli for logistics developments together with its variables, the exploratory phase was followed by establishing the stages of evolution in logistics from an historical perspective, initially in the army/military and then in commerce/business. Although its purpose was of a secondary function, this historical grounding/foundation phase proved very instrumental in the process of model construction and hypothesis generation which occurred later. Next, a full understanding of the relevant and pertinent responsive theories appertaining to logistics were sought, which set the scene for a full development of the quick/rapid (efficient consumer) response logistics model to be explained and delineated. From all the above, a novel breakdown of the variables of logistics became possible, and their cogency explained and understood. Armed with the above preparation and knowledge, the author was able to construct a conceptual "types of logistics" model, which enabled a 'theory testing' research environment to emerge using case studies mainly (with a 'focus group' and a 'Delphi perspective').

Therefore, the two qualitative hypotheses postulated for this thesis are:-

(1) With a prime emphasis on supply, there is no fundamental difference between military and commercial logistics; and

(2) Both military and commercial logistics systems can be analysed and compared according to four distinct logistics types. (As depicted in Figure 8.1 (page 226).)

(N.B. Two *qualitative* hypotheses having been postulated, a path towards their *corroboration* or appraisal was sought, and *not* verification, because of the distinction made by Popper (1972:251, 265) who stated: "Theories are not verifiable, but they can be 'corroborated'." and he continued with "... corroboration can only be expressed as an appraisal." The normal/usual quantitative 'statistical acceptance testing' could not be pursued/employed for these hypotheses in this thesis.)

A primary research design/methodology of predominantly grounded theory analysis of qualitative data, collected mainly via case studies, was planned and executed. Also, a secondary research design/methodology formulated of historiography was conducted. This was considered the very appropriate because of the political aspects - from, and within, both sectors - that emerged early on in the initial exploratory research, which suggested that access to, and aquisition of, suitable *live* data might be difficult. The analyses of the data was conducted by grounded theory which then allowed conclusions to be drawn.

1.4 Structure Of The Thesis

As a preparation for the reader, below is a brief outline of the structure of this thesis:-

Chapter 2: After a general introduction, this chapter includes a *prima facie* comparative analysis which is based on a literature survey/review. This initial exploratory study provides the views of past researchers, authors/commentators and, it furnished the author with the interesting concepts/principles and details which served to embrace the elements of the field of study for this thesis.

Chapter 3: The work contained here originally commenced as a contingency measure in the event, or the likelihood, of not having access to sufficient *live data* in the military domain. From a literature survey/review - mostly secondary sources (using advice from: Stewart and Kamins, 1993) - some original film footage owned by the Imperial War Museum (London), and some eyewitness accounts of the most recent encounters, an historical evolution of military logistics is tracked in this chapter. The approach adopted here was one of using *historiography* and *critical incidents* (Flanagan, 1954; Neuhaus, 1996) (for instance: a war/battle is a critical incident; so are heralded publications/treatises in the field of military logistics and the introduction of certain technologies/inventions/schemes). Assessments of the stimuli and prompts for the changes in, and advancements of military logistics are made and catalogued, together with comments on the specific impacts that these have had throughout time. This chapter also provided much data for, and enabled, the drawing together of the main variables of military logistics that are elucidated in Chapter 7, as well as, hypothesis generation.

Chapter 4: As the chances of obtaining *live data* from the commercial/business sector appeared very slim at the outset of this study/research, the work conducted in this chapter was primordially a *back-up* measure. Here, again from the literature, an historical evolution of commercial/business logistics is traced/tracked, using the principal authors/contributors/gurus in the field as the milestones. The works and comments from such people and some eyewitness accounts of the more recent aspects were pursued for the evolutionary path of commercial/business logistics, mostly from the commencement of the 20th century. In addition, the work for this chapter yielded data that is employed in the logistics variables outline contained in Chapter 7 and for hypothesis generation.

Chapter 5: This chapter contains and explains the relevant and pertinent theories, concepts and principles of (responsive) logistics that apply for this thesis.

Chapter 6: In this chapter is a description of how quick/rapid (efficient consumer) response logistics functions. By using the concepts portrayed in the preceding chapter, it is then shown how the amalgam of these principles, in a certain configuration, coupled

with partnerships, relationships, and the enabling computer/information technology, work as a system.

Chapter 7: As a completion of all the above work, an attempt is made in this chapter to cover the dimensions and variables of logistics in a novel fashion with explanations of how these apply to both commercial and military situations/scenarios. Also, this chapter contains an introduction to Performance Indicators and Benchmarking.

Chapter 8: This chapter explains how Gattorna's systematic approach for analysing logistics was used to construct a *logistics types* matrix, thereby creating the principal hypothesis for this thesis.

Chapter 9: Starting with the basic epistemological and ontological foundations, the research questions, design and methodology used for this work are outlined here. The case study approach - with multiple sources and forms of data collection - was the chief method employed, but some use of focus groups, the Delphi process, critical incidents, in-depth structured and semi-structured interviews was made, and other techniques were employed also.

Chapter 10: This chapter lists and gives an outline of the case studies, focus group and Delphi perspective that were conducted for the data collection. It was these case studies coupled with the focus group and Delphi technique that provided the data for the *primary* (and therefore, principal) research of this thesis.

Chapter 11: This chapter includes the analysis and the ensuing results. Most of the data outcome was tabulated and/or 'placed' in the appropriate part of the hypothetical matrix.

Chapter 12: Discussion and conclusions.

Chapter 13: The references and bibliography used for the thesis are in this section.

Chapter 14: Appendices, containing all the principal details from all the case studies (with the 'focus group' and 'Delphi perspective') coupled with their 'data and findings sheet'; there is also a sample interview transcript.

This thesis of comparison commences properly over the page.

2. LOGISTICS - THE ARTERIES (AND VEINS) OF COMMERCE AND MILITARY FORCES

"A military maxim has it that amateurs talk about strategy while professionals talk about logistics."

Time magazine, 20th August 1990

After a general introduction, this chapter contains a *prima facie* comparative analysis which is heavily based upon a literature survey/review. The initial exploratory inquiry/study provides the views of past researchers, authors/commentators and, it furnished the author with the interesting concepts/principles, some variables and details which served to embrace the subsequent elements of the field of study for this thesis. Herewith is encompassed the inquiry work (via a *basic* 'grounded theory' approach) that formed the understanding and foundation for this thesis. The search for information with the comments/views made by past researchers/commentators, helped in providing the underpinning, and finding or locating the direction, route, course and positioning, of this research.

2.1 The Origin Of The Word Logistics

'Logistics' as a word probably came from two sources: the Greek word *logistikos* and the Latin word *logisticus* both of which mean "skilled in calculating" (i.e. in the mathematical sense); and the French verb 'loger' meaning "to lodge or quarter". Boardman et al (1991:188) referred to the departure from *laissez-faire* government in the Roman Empire at the end of the first century AD when appointments of *logistai* (i.e. accountants) were made. Although during the Roman and Byzantine Empires the word 'logista' was used as a title for a rank of a military administrative official, it was not until the 19th century that the term logistics was really used - in military parlance at least - by Antoine Henri Jomini[5]. In his celebrated book "*Precis de l'art de la Guerre*" Jomini (in Hittle, 1947) built a theory of the art of war on a trinity: Strategy; 'Grand' Tactics; and Logistics. His main interest was not the actual art (or science) of logistics, but with military management as a whole - as was the logista's (administrative role) mentioned above. In spite of the considerable influence of Jomini's writings on military thought during the mid 19th century, his limited tract on logistics attracted little attention. The strict interpretation was applied to the supply, quartering and movement of troops. Logistics was not properly introduced until the late 19th century when Admiral A.T. Mahan (Alger, 1985) introduced it into the US Navy. Mahan's interpretation of logistics grew to include the process of industrial mobilisation.

All through World War One (WW1), the word logistics was used little, and when it was, it was restricted to the administrative sense. World War Two (WW2) enabled

[5] Antoine Henri Jomini was Napoleon's biographer and the leading military theorist in Europe during most of the 19th. century.

logistics to come into vogue; the term was used indiscriminately, and it tended to lose the more focused sense. Alger (1985) made reference to Thomas E. Griess, who studied the process of change in military history; Griess focused on common factors that were a part of the military profession or affected by that profession. He called these common factors "threads of continuity" which he differentiated into internal threads and external threads. The four internal threads of continuity were: Military Professionalism; Tactics; Strategy; and Logistics and Administration. Griess grouped logistics with administration; like Jomini and the logistai above, the emphasis was on management. Huston (1966:656) too, campaigned for: "... the *equivalence* of strategy, tactics, and logistics." He continued (Huston, 1966:663): "... it was no use engaging in dreamworld strategy divorced from logistical feasibility." The debate concerning the relationship between strategy, tactics and logistics still continues today as Papararone (1995:14) demonstrated in his plea to make logistics a "co-equal" constituent.

Since the conclusion of WW2, the number and complexity of weapon systems have grown rapidly. Modern technology brought with it vast changes in communications, transportation, materials, weapon systems, data processing and management. The very nature of warfare began to change in terms of rapidity of attack, severity of weapon effects, increased territorial scale and scope, a variety of foci, and complexity of management requirements (Van Creveld, 1992 and 1992a). To assist itself, the Army broadened the term logistics and commenced developing operational research techniques and mathematical modelling to assist in that complexity of management requirements. These areas were defined and support modelling (mostly logistics) became a key element in progressing the planning and operation of supply and support functions of the following seven aspects (from Drezner and Hillestad, 1984:204):-

- forecasting resource requirements;
- purchase, stockage, distribution, and data handling for spares, ammunition, fuel, food, medical supplies, and construction materials;
- transportation system design and utilisation for peacetime support and strategy mobilisation;
- designing maintainability and reliability into weapon systems;
- maintenance management policies including inspection, replacement, and workload scheduling;
- communications, including the design of message and transmission systems; and
- personnel and training requirements for maintenance of weapon systems.

In many cases it was the military needs that initiated the operational research arena and developed methods like: linear and dynamic programming; networking and queuing techniques; inventory, reliability, and decision theory; simulations (both man-machine and machine); and statistical models/modelling. (Indeed this emulates the 'skilled in calculating' Greek/Latin origin of the word logistics mentioned above.) Many of these

modelling techniques are now applied in business; there has been a transfer of modelling techniques from military to non-military. As business has further developed and refined these techniques there has been a reverse transfer. Indeed the transfer is beginning to be two way, i.e. a constant interplay.

Since WW2, logistics has risen in significance in both the military and commerce/business/industry. In fact the 'Gulf Conflict' is known as the 'Logistician's War' (Addy, 1992; Sharman, 1991 and 1991a). The logistical effort for Operations Dessert Shield and Granby[6] greatly contributed to the success achieved during the short duration of the conflict. Likewise, for the British Forces, logistics played a very important role in the Falklands Conflict of 1982 (Thompson, 1991:249-288).

A military definition of logistics given by NEVEM (1989:1) was: "All preparations and actions necessary to supply the armed forces in the most efficacious manner with goods and supplies, leaving them the most favourable circumstances to battle." The definition for military logistics given by NATO (1989:19-20, paragraphs 203, 205 and 206) is:-

"**Logistics:** The science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, those aspects of military operations that deal with:

(a) design and development, acquisition, storage, movement, distribution, maintenance, evacuation and disposition of materiel;
(b) movement, evacuation and hospitalisation of personnel;
(c) acquisition or construction, maintenance, operation and disposition of facilities;
(d) acquisition or furnishing of services.

Production Logistics: That part of logistics concerning research, design, development, manufacture and acceptance of materiel. In consequence, production logistics includes:

standardization and interoperability, contracting, quality assurance, procurement of spares, reliability and defect analysis, safety standards for equipment, specifications and production processes, trials and testing (including provision of necessary facilities), codification, equipment documentation, configuration control and modifications.

Consumer Logistics: That part of logistics concerning reception of the initial product, storage, transport, maintenance (including repair and serviceability), operation and disposal of material. In consequence, consumer logistics includes stock control, provision or construction of facilities (excluding any material element and those facilities needed to support production logistic facilities), movement control, reliability and defect reporting, safety standards for storage, transport and handling and related training."

From a war perspetive, Eccles (1959:49) made a distinction between "civil logistics"

[6] "Operation Granby" was the name of the British deployment for 'Operation Dessert Shield'.

and "military logistics", the former being "the mobilization of the civilian industrial economy to support the armed forces", and the latter "the supplying of men and material, and the rendering of services, to the operating military forces." An interesting point to note is that both NATO (i.e. (d) above) and Eccles included the term *services* in their explanations/definitions.

Although logistics has its origin within the military (every dictionary definition of logistics the author has seen refers to the military context of moving, quartering and supplying forces, and maintaining fighting equipment), today logistics is recognised as being a major contributor to improving the performance and attainment of objectives of any enterprise/organisation - military or commercial. Commercially, logistics comes under a variety of names (Lambert and Stock, 1993:4):-

Physical distribution	Materials management
Distribution	Materials logistics management
Distribution engineering	Logistics and/or Logistics management
Business logistics	Quick-response systems
Marketing logistics	Supply chain management
Distribution logistics	Industrial logistics

All these terms are underpinned by a concept of an integration of many activities and refer to the conversion and flow of goods from point-of-origin to point-of-consumption. A definition of commercial logistics management compiled in 1985 was:-
"The process of planning, implementing and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished goods, and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements."[7] Seven years later, in 1992, the Council of Logistics Management added a single word - *services*. The new definition became: "The process of planning, implementing and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished goods, ***services***, and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements." [Bold emphasis was added by the author.]

The notion of services being an aspect of logistics had been thought of at least 76 years before its adoption in the above definition by Shaw (1916:110). Heskett, Ivie and Glaskowsky (1964:51) referred to the services aspect of logistics too. Also, Schary (1970:73) commented: "Service as an element in logistic strategy involves a transfer - a shifting of functions from one firm to another, the avoidance of a cost on one side to be incurred on the other. Using service as a marketing tool is then identification of the customer's logistic costs and absorbing them as one way of applying the resources of the

[7] Definition provided by the Council of Logistics Management (CLM), USA, 1985.

firm to the specific needs of the market. ... The elements of logistic service can be divided into time and non-time related elements. Time-related service is related to the inventory order cycle. Superior service in the context of the customer's order cycle time reduces the time interval for decision as well as his inventory cost. Other elements of service can be provided for the customer in substitution for his own functions. In fact the whole concept of service in logistics can be regarded as a shifting of costs."

Planning, implementing and controlling are universal management functions. Shapiro and Heskett (1985) offered a layperson's description of logistics as the seven Rs: "ensuring the availability of the *right* product, in the *right* quantity and the *right* condition, at the *right* place, at the *right* time, for the *right* customer, at the *right* cost." The use of the word 'availability' is an interesting one; availability will become prominent in a later part of this thesis particularly within the context of military logistics.

Christopher[8] (1994) offered these two explanations: "Supply chain management can be defined as the management of upstream and downstream relationships with suppliers, distributors and customers to achieve greater customer value-added at least total cost." And "The goal of supply chain management is to link the market place, the distribution network, the manufacturing process and the procurement activity in such a way that customers are serviced at higher levels but at lower total costs."

So, logistics came from a Greek, French, Roman and Byzantine beginning, adopted by the military as an administrative, management and planning function, and currently is becoming fashionable in business/industry for the management of the total material flow, as Peters (1992:291) stated: "In fact, I suspect that the only truly effective giants (in the "old big" sense) in tomorrow's world may well be distribution goliaths-...". Brewer (1960) introduced another word of Greek origin 'rhocrematics'[9] which means 'the science of the flow of materials and products from their sources to their final disposal'. The use of the word 'disposal' should be noted as this will be referred to again later.

The financing of military and business logistics - quite naturally - is different. Smykay (1964-65:2) offered the following explanation: "... budgetary constraints of military logisticians and of business administrators do not completely coincide. Whereas military budgets depend upon political appropriation, private enterprise budgets are based upon markets and competition. Military budgets are implemented by sanctioned authority; private enterprise budgets are founded upon sales revenue. Military logisticians may enjoy *ad hoc* budgetary increases; a businessman's budget is largely restricted by his satisfaction of customer requirements. Briefly stated, the success of military logistics is

[8] Prof. Martin G. Christopher gave these explanations in a lecture to MBA students - 14th. May 1994 at the Cranfield School of Management, Cranfield University, UK.

[9] Rhocrematics comes from one of two Greek words which mean 'flow' or 'stream'.

founded upon authoritarianism; the success of physical distribution in private enterprise depends upon market competition and customer good will."

But are the logistics of military and business the same? What are their similarities and dissimilarities? In the preface of his acclaimed book Huston (1966:ix) wrote: "Today, as a basis for decisions of public policy and military action, civilians as well as the military require some experience in military logistics." He does not proceed to qualify the statement regarding 'civilians', but it is probably aimed at civilians working within the defence departments/ministries; however, 'public policy' encompasses much more and he may have been hinting at this? In his treatise on military logistics, Magruder (1991:73) advised: "New and successful commercial management practices must always be considered for possible adoption by the military". Sharman (1991a:35, 51), suggested that the Gulf experience provides some useful lessons for global commercial enterprises.

Roll-on/Roll-off (Ro-Ro) ferries (which came from, or are derivatives of military amphibious beach landing crafts), the wooden pallet and containerisation (Doyle, 1964:104) are examples of the transfer of good operating logistics techniques from the military to the business sector. Like most new practices, the wooden pallet caused problems whilst it was being pioneered within the distributive trades, as Gattorna (1977:252) reported: "The flat wooden pallet was a carry-over from World War II; the U.S. Army were using the pallet for materials handling tasks towards the end of the war. Food and grocery manufacturers realized the potential of this piece of equipment and initially used it for moving product within the confines of the manufacturing facility. Its use gradually spread to outside delivery, and initially caused wholesale and retail customers many major problems; for example, the volume of goods was much higher than distributors were hitherto used to handling and selling. Certainly, they lacked the equipment to handle such heavy loads. Many smaller independent stores were squeezed out of business about this time and counter strategies from the retail sector included formation of Symbol Voluntary Group organisations and the introduction of Cash & Carry type wholesaling." As with any change management programme, proper planning and communications with all the participants are vital for quick success.

Also, this may be the first record of how 'power-play' in the supply chain was used for competitive advantage, as Gattorna (1977:252) continued: "Initial introduction of the traditional wooden pallet into distribution channel systems by manufacturers some twenty-five years ago [i.e. circa 1952][10] caused severe problems in the distributive sector; now it seems the tables have been reversed. The ability to succeed in imposing such large-scale changes obviously implies the presence of power. There appears to be no basis for thinking that similar events will not or have not already occurred in other industries." Gattorna's prophecy was one that came true as will be shown later.

[10] Comments in brackets added by the author.

2.2 Previous Work

2.2.1 Rider's Work

In his constitutive (i.e. essential components) approach research enquiring "What is logistics?", Rider (1970) through his desk research, literature review and simple questionnaire survey concluded that logistics was a set of work-functions, system processes and socioeconomic functions. He compared these functions with their appropriateness to the business and military sectors and produced the table shown in Table 2.1 (Rider, 1970:115).

Rider (1970) concluded that the set of work functions was common to both business and military, but the military also included order processing, maintenance and facilities engineering; obviously, the latter two are solely military logistics functions. Notice the omission of order processing in the business function column. Surely this was not the

Logistics as a ...	Business Function	Military Function
Set of Work-Functions	Procurement Traffic Management Warehousing Inventory Control	Procurement Traffic Management Warehousing Inventory Control Order Processing Maintenance Facilities Engineering
Set of System Processes	Acquisition Movement Storage	Requirements Acquisition Movement Storage Conservation
Socio-Economic Function	Physical Supply Physical Distribution	Physical Supply Physical Distribution

From: Rider (1970:115)

Table 2.1 Constitutive Comparison of Commercial Vs Military Logistics

position in 1970? How did Rider (1970) miss the article by Stewart (1965:66) who included 'order processing' as one of his distribution system *activity cogs*? Clearly, as then, order processing is seen as a business logistics work function today, as Kotler (1991:558) stated: "Physical distribution begins with a customer order." Also, A.T. Kearney Inc. (1978:186) in their study said: "Order processing may be compared to the human body's central nervous system, triggering the distribution process and directing the actions to be taken in satisfying order demand." In such a study as Rider's conducted today, order processing would undoubtedly be included in the business logistics work function.

For the set of system processes, Rider (1970:115) saw the business and military set being differentiated by requirements and conservation added to the military sector. This is possibly still the situation today, although requirements bear looking into and analysing. As for the socio-economic function, today physical recyling, reuse and/or reclamation would probably be added as a business function; and for the military function physical recovery would probably be added as they invariably recover, clear-up and remove their wares post any conflict/battle, etc. reclaiming where possible.

2.2.2 Roth's Work

In his research, Roth (1991:462-463) concluded that the Roman army could not have conducted the Jewish war by foraging and living off the land alone, therefore supply lines must have been used. The countryside vegetation, terrain and water availability during that era were incompatible with the sustainment of large armies, and Roth (1991:471) concluded: "It is often noted in logistical studies, that a major constraint on the carrying capacity of a force is the size of the train. Wagons and pack animals take a tremendous amount of space. All of the wagons or pack animals necessary to supply the army for a month could not possibly have accompanied the soldiers, as the train would have been much too long. The only possible solution to this difficulty is the use of depots and convoys. Thus only a fraction of the wagons and pack animals would have been necessary, as supplies would have been shuttled forward to the army over a series of intermediate storage depots. Supply lines involved a tremendous amount of expense and planning, but they gave the Roman forces a tremendous operational flexibility, and greatly contributed to the staying power which was the hallmark of the Roman military force." This aspect of mobility for military forces is of paramount importance and a phrase that is coined today about the logistics 'weight' and 'size' holding back, or the lack of supplies to, the front-line(s) is "logistics drag".

Whilst Roth (1991) concentrated his research primarily on food supplies and dietary aspects, he commented on the major logistical problems the Romans had with supplying firewood for cooking and/or baking during the Jewish war, and that they had a specific

name/term for this function called *lignatio* (Roth, 1991:216-217). Also, water, although collected daily (known as *aquatio*), was rationed, and there is some evidence suggesting that, to make the water go further, the Romans used to mix it with sour wine (*acetum*) to produce *posca* (Roth, 1991:170-171).

2.2.3 Kim's Work

One of the concepts introduced by Kim (1996:120) was a "logistics feasibility gap"; a logistics feasibility gap exists when the 'availability of logistics means' is less than the 'requirements for logistics support'. This gap calls for strategic logistics management perspectives thus providing the strategic linkage between the 'strategic perception on logistics leverage' and the 'strategic competence of logistics capability'. A predominant finding of Kim (1996:236) was that "... four major components were observed to be more influential to the result of war: organisational structure, resource availability, high technologies, and effective combat support. The case study resulted in the identification of a military requirement for strategic logistics management." Kim (1996:236) continued with: "The findings in the benchmarking process show that military logistics can obtain many valuable insights (for improving logistics management) from the business sector. The military's direct adoption of a business practice or system is not desirable, but the process-oriented benchmarking approach would provide some benefits to the military."

One of the recommendations of Kim (1996:240) was: "Military logistics has been developed differently in different countries. At the same time, war is conducted differently according to the enemy, terrain and resource availability. Therefore, multiple case studies in military logistics would reveal any significant similarities or differences based on the situation. The research would contribute to the generalisation of the military logistics concept."

2.2.4 The Works Of McGinnis, Russell And Southworth

Some desk research comparisons between military and business logistics have been conducted, notably McGinnis (1992) and Russell (1995). The collation of logistics principles from the prominent literature of both the military and the business arenas was the aim of McGinnis' (1992) work and he selected seven principles of military logistics that may be applicable to business logistics - these were: the interdependence of logistics with strategy and tactics; overlap (this is where a logistics process is the responsibility of two or more organisations); limitation and balance of resources; priorities[11] and allocations[12]; information; feasibility; and flexibility (McGinnis, 1992:26). For the business logistics twelve principles were selected (McGinnis, 1992:29): postponement

[11] Priority means the setting of precedence in time, order and importance.

[12] Allocation means the apportionment of resources.

and speculation; standardisation and customisation; consolidation; differentiation; interdependence of logistics with strategy; overlap; limitation and balance of resources; priorities and allocations; information; feasibility; flexibility; and importance of performance measurement. The conclusion was that at the end of the 1980s, six principles were relevant to the business logistics environment: (1) Logistics as a part of strategy; (2) Overlap; (3) Information; (4) Flexibility; (5) Priorities and allocations; and (6) Performance measurement (McGinnis, 1992:30). Further conclusions by McGinnis (1992:31) related the logistics of the two sectors by: multifaceted logistics processes; complex logistics processes; and logistics processes occurring in dynamic and unpredictable environments.

The work of Russell (1995), with more of an engineering bias, drew attention to twelve emerging practices in business logistics that came from traditional military logistics. These twelve new similarities had a remarkable convergence of logistics concepts and terms between military and business. The twelve converging aspects were: life cycle; cycle time; integrated logistics support (ILS); redeployment or retrograde logistics; life-cycle cost; logistics engineering; demand; contingency planning; logistics database; logistics commanders; sub-optimisation; and, contractor versus organic support (Russell, 1995:38-40). One of the conclusions of Russell (1995:40-41) was "... that the wide chasm that seemingly separates these two aspects of the discipline may be more perceptual than real. As a minimum, the differences are narrowing and are seemingly more of focus than of fundamentals. ... Both have a growing common vocabulary."

Another piece of work was conducted by Southworth (1989) who contrasted inventory control and forecasting methods between the two sectors. He explained the British Army's rationale for their large stocks, Southworth (1989:Chapter 2, pp 8-9): "The concept of maintaining large stocks of material in the United Kingdom is based partly on historical events and partly on the need for flexibility. Historically there are two major events which still influence the rationale of the system. Firstly, the Dunkirk mentality stipulates that never again will so much material be committed to an overseas theatre without an adequate reserve in the home base, this policy is of course tempered by the need to have spares in strategic locations. Secondly the logistic system used during Operation Overlord[13] in Normandy was so successful that the system has remained ever since, albeit with some improvements. The system known as Close Theatre Maintenance was based on small Royal Army Ordnance Corps (RAOC) units following closely the fighting elements and resupplying them with fast moving stores. After consolidation an advanced Forward Ordnance Depot would then be set up to supply a far wider range of fast moving stores and hold a reserve for the smaller units."

Southworth (1989) also explained the Standard Priority System (SPS) which existed

[13] "Operation Overlord" was the code name given to the D-Day Landings on 6th. June 1944.

for vehicles and equipment to provide a means of ensuring that the units with the highest operational status received stocks first. The effectiveness of the SPS and therefore its value to the units depended on how those units chose to operate the system. The SPS is based on two major factors: the first is the Force Unit Designator (FUD); the second is the Urgency of Need (U of N). When the two are matched in the SPS matrix they form the priority code (ranging from 01 to 16) at which a unit should demand spares. The FUD is categorised into four levels which are calculated by the MoD and relates to the importance in the order of battle possessed by each individual unit within the British Army. Units are assessed according to their contribution to the war winning element of their role in war - only the MoD can change a unit to the FUD 1 level. FUDs are not open to discussion; however, the majority of units would become FUD 1 units once hostilities have commenced. The ability of units to manipulate the system to get what they need/want, when they want it, is decided by the urgency of the requirement. 'U of Ns' have five levels coded A to E and relate to a time scale in which the Royal Logistics Corps (RLC) will deliver spares. The A, B and C level 'U of Ns' relate to operational vehicles and equipment only. This point is often overlooked by units because a definition of operational vehicles tends to be dictated by the wishes of the Commanding Officers, (this is an indictaion of where the power lies in a military supply system).

From the FUD and 'U of N' an SPS code can be determined from the SPS matrix ranging from 01 to 16. See Table 2.2 for the matrix. The priority sytem was easily and frequently abused as Southworth (1989:Chapter 2, pp 34) illustrated: "A recent 01 priority demand, normally only used in war, for an ash tray for a staff car highlights the abuses placed on the system."

	Urgency of Need				
FUD Level	A	B	C	D	E
I	01	02	05	09	13
II		03	06	10	14
III		04	07	11	15
IV			08	12	16

Table 2.2 The British Army's Spare Parts Priority Matrix

2.2.5 The Views Of Doyle And Hauk

Doyle (1964:101) commented that the probable cause for closer contact between business and military logistics was the magnitudes of their operations and that businesses

were interested in the 'coordinated logistics concept' which had been practiced by the military. He (Doyle, 1964:102) contended that both types of logistics were 'packages of actions and activities' (essentially assembly, storage, processing and distribution) and that logisticians of both sectors were motivated by "... dedication to success in their chosen field and ambition to advance to positions of greater influence and higher pay, most likely in that order." Calculations of logistical requirements were the same for both sectors and once operating rate/production goals were set, meeting predictions would be relatively simple if originally well analysed (Doyle, 1994:103); some markets were unpredictable and such was the behaviour (intentionally), of the enemy, in military terms. Doyle (1964:103-104) argued that site (location) and transportation considerations were the same for both logistics types and that both groups were very cost conscious with similar objectives to increase efficiency and reduce cost.

Another common feature of the two sectors was the great difficulty faced by the logisticians in getting their story/message across to managers/commanders (Doyle, 1964:104-105). Following on from this point, another observation Doyle (1964:106) made was that logisticians rarely became top commanders/businessmen. Doyle's (1964:105) conclusion was "... there is so much similarity between military and business logistics ..." However, three pertinent differences were indicated by Doyle, these were:-

Whilst poor/bad logistics in a business might result in low profits, it does not necessarily mean, or follow, that the business itself would fail. Whereas in the military, poor/bad logistics (i.e. inadequate provisioning) could compromise operations that a battle, campaign or even a war might be lost.

The lack of precise information (a usual position for the military engaged in combat) could cause estimates to be 'way off'. Under such circumstances unexpected initial success could be at the root of logistical failure. For instance, having pushed forward (after countering fierce opposition), to a mission destination, the resources and support become insufficient to complete the mission.

The military conducted much 'on-the-job' training and that civilians should adopt this approach.

Hauk (1964:14) contrasted the fact that military logistics included the transportation of personnel, whereas business 'logistics' (he actually used the term 'physical distribution'), did not. The magnitude of the two sectors was compared when he commented (Hauk, 1964:17): "The magnitude of supply in each branch of the Armed Services greatly exceeds that of any single manufacturer in the private economy. ... The Army alone has about one million catalogued items in its system, ... the inventory carried is about one third the magnitude, in dollars, of all inventory carried by all manufacturers in the United States." In addition, he (Hauk, 1964:17) referred to military logistics having the role of *need analysis*, with a desire to have 100 per cent service with regard to parts and equipment availability - this would be far too expensive for the commercial

world; also as the military was not a producer of goods (solely a buyer, distributor and consumer), the *plant location* (i.e. factory location/placing) problem/enigma was not important to the military. With competitive forces in the business world, distribution efficiency was important, but, as it could not be measured/evaluated easily, an enterprise's consumer's patronage was registered by profit performance - this was absent in military logistics management (Hauk, 1964:18). The concluding comment by Hauk (1964:19) was: "Private business can learn from, as well as instruct, the military on such matters. For this reason as well as others, we need more research to contrast and clarify physical distribution in the two sectors."

2.3 Initial/Exploratory Research Enquiry Methodology

This initial exploratory study attempts to discuss and answer those questions raised above, with a hope of building a pontoon between the two sectors for interchanging principles and practices to enable all logisticians to benefit. The 'unit of analysis' chosen was the Army (for the military side) and commercial/business logistics principles, practices and procedures. In each of these a 'comparative analysis' was conducted to critically assess, analyse, compare and contrast the two logistics modes. For this initial exploratory study the sources of information have been literature reviews/searches, historiography, some visits and semi-structured interviews with personnel from both sectors, and desk research to collate the total via a crude 'Grounded Theory' approach.

Grounded Theory (Glaser and Strauss, 1967) is neither a hypothetico-deductive method nor a new paradigm method, but a process of analytical induction. Grounded Theory works by entering the field collecting data without a hypothesis, generalising findings into statements describing what happens and regarding possible relationships involved, and checking out these statements by further data collection to a point where explanations are formulated as to why 'it' happens or occurs on the basis that the types of results/observations can be categorised. Therefore, theory is discovered or generated from data rather than being abstract and tentative.

Most of the research conducted in military logistics outside of operational research is via 'historiography'. Some researchers frown at this approach. However, as Goodman and Kruger (1988) have demonstrated, when historiography is pursued in an 'objective manner' the outcome can be accepted as suitable data for research conclusions. In fact, their conclusion indicated the power within historiography (Goodman and Kruger, 1988:323): "The method's advantages are in variable evaluation and selection, theory construction, and hypothesis generation." Most of the secondary military data illustrating this thesis came from the historiographical methodology. However, a cautious perspicacity has to be taken when using historiography and secondary data, in general: it has to be authenticated; its suitability as evidence supporting or refuting an interpretation

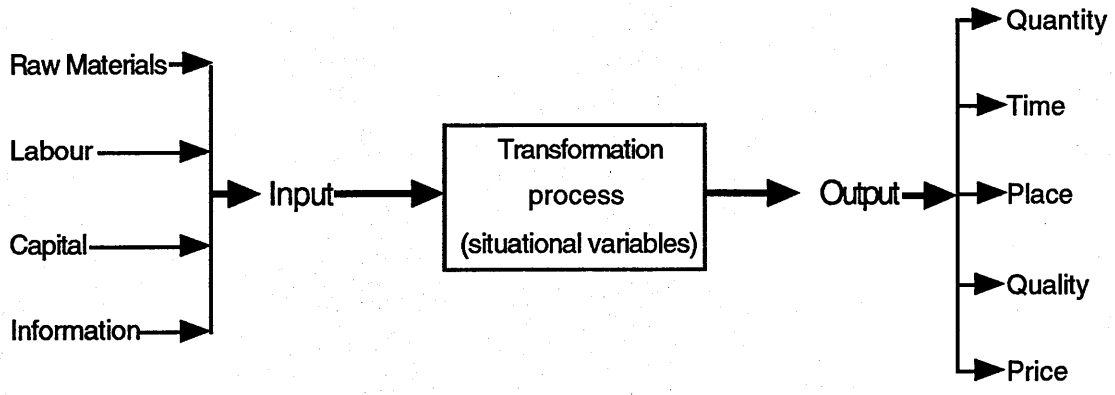
needs evaluation; the knowledge of its original data collection purpose should be known and; the motive (or bias/prejudice) of the author/historian would help in avoiding: its misuse; making wrongful comparisons; and the drawing of false conclusions and/or paralogisms (Stewart and Kamins, 1993).

An initial comparative analysis enabled a culmination which was explanatory, descriptive and exploratory (Yin, 1994:138) in the pursuit of 'pattern-matching' (Yin, 1994:106-110). The chief variables involved were: information (i.e. order) handling methods/procedures; correct product(s) and quantities; type of controlling scheme (i.e. re-order points (ROP), time phased order points (TPOP), EOQ or EBQ, MRP, MRP II and DRP II, just-in-time (JIT), OPT, etc.); inventory management and warehousing; shape of the logistics network (i.e. 'nodes' and 'links'); space; speed (i.e. time and distances); modes of transportation; incorporated added value within the logistics system; third party involvement; customer service; and enabled synergistic responsiveness within the whole. The logistics modes are the various combinations that can be permutated from different arrangements of all the above variables. To be able to distinguish and appreciate logistic systems, the connection of the whole system must be properly understood together with the relative dependency of its several parts.

2.3.1 Comparison Of Transformation Model

Some commercial logistics books Cannon (1973:11), NEVEM (1989:5), and, Rushton and Oxley (1989:4) commence by illustrating the forward flow of raw materials - with other resources - through a metamorphic process and onward to the consumer. Using the simple transformation model from NEVEM (1989:5) shown in Figure 2.1, a detailed examination of this model may help to establish if it is worthy of both commercial and military use.

Firstly, to an industrialist Figure 2.1 is a generalised first representation of any manufacturing entity. The inputs of: raw materials; labour; capital in the form of fixed assets; and information - both forecasts of demand and technical data for process management - are transformed or converted within a factory (or in an office if considering a service type entity) by adding value and providing the required outputs. The outputs consist of: quantity - amount produced in total or for a specific customer; in some timeframe or at a specific time (Stalk, 1988; Stalk and Hout, 1990; and Drucker 1990:98); delivered to a specified place; at a defined quality level; and at the right price - all of the *rights* (i.e. the seven Rs) purported by Shapiro and Heskett (1985) quoted above. The output of price can be viewed in two ways: firstly the price to the manufacturer (or servicer) i.e. his costs of operation, or producing the article(s); or secondly the actual price charged to the customer - the difference between the two being the profit margin. So, can this same model be used to illustrate military operations?



(Source: NEVEM, 1989:5)

Figure 2.1 The Transformation Model

Prima facie, in the military sense the inputs are:-

Raw materials	=	ammunitions/bombs/mortars/mines/missiles/torpedoes, etc.
Labour	=	soldiers, sailors, marines and airmen.
Capital	=	tanks, warships, aircraft-carriers, submarines, jet-fighters, etc.
Information	=	intelligence about the enemy, and operating data for the kit.

The transformation process is the "war or battle" - this certainly changes the state of things. What are the outputs of a war/battle as depicted in the model? They are *prima facie*:-

Quantity	= the amount of ground/territory/area/entity taken/conquered.
Time	= the time within, or at which a mission should/could be completed.
Place	= most campaigns have a defined destination or end place; also the place for delivering supplies to (point of delivery), changes as advances or retreats are made (a sort of mobile delivery point) throughout the course of the battle/war/conflict.
Quality	= precision target bombing (solely military targets); minimum damage to property; minimum human injuries and fatalities. Constraints like these are quality aims.
Price	= the cost of supporting the campaign, plus the loss of equipment and the human injury and lost life incurred by each side.

Therefore, the transformation model Figure 2.1 is applicable to both military and business and may be considered to be the beginning of a generic model.

2.3.2 Comparison Of Principles And Functions

In order to assist with the comparative analysis, Table 2.3 was drawn-up from the Grounded Theory procedure to indicate at a glance the outcome of the analysis. The

columns shown are fairly self-explanatory, but the military column has been divided into two because there is a difference regarding logistics in peace or a 'conflict' (time of tension) situation. (Confirmation of such a divide was found by Hauk (1964:14) who wrote: "... differences can be noted between war periods, peacetime, and periods where defense is geared to a strategy of preparedness for massive retaliation within 15 minutes notice.") The word conflict has been used and not war because the UK has not had a war since WW2. Both the Falklands and Gulf campaigns were conflicts, i.e. war was never declared, the Queen's Order was not signed or given (Addy, 1992:1, 4) and thus they are referred to as conflicts. It is important to note that training too comes within the conflict column. As training manoeuvres are an attempt to simulate the reality, all the logistic functions/lines and support structures need to be tested by the training exercise as well. It is for this reason that NATO (1989:23) paragraph 214(g) states: "Logistic practice must be the same in peace as in war. (Ministerial Guidance 1977)." In reality, apart from training, economies are sought in peace time, (for example, Kissinger (1957) contrasted "doctrinal", "technological" and "fiscal" influences on the US military strategy and concluded that the fiscal, as well as the technological, had been too influential at the expense of military doctrine). A very active military logistics time is during the 'transition to war' phase when the logistics structure and network shape are formulated, according to the conflict type and assessed intensity level.

Taking each aspect individually a comparison can be made:-

2.3.2.1 Objective/Purpose

In business the purpose of logistics is to provide customer service at a profit. West (1989:193) wrote: "Though a particular delivery system meets a majority of output criteria, the distribution planner cannot ignore constraints placed upon the system by the customer. After all, it is the customer that the system is being designed to service. The location of customers may in certain instances determine the effectiveness of certain types of physical distribution system in servicing them." He also recommended that after grouping customers, their requirements should be identified through the process of customer service definition. West (1989:248) continued with: "This permits the establishment of a differentiated service, matching service provision to customer requirements, thereby minimising cost while maximising competitive advantage." Here, West advocated a 'pull' system, which is one that is 'demand driven', as opposed to a 'push' system which is 'supply driven'. Coyle et al (1992:81) stated how difficult it is to explain the nebulous term of 'customer service', and continued (1992:83) with: "The customer is concerned with the total product he or she is purchasing, not merely with its physical characteristics of the goods. The level of logistical customer service is important to the augmented product and may very well have effects upon customer response satisfaction similar to the effects of price and other physical characteristics." Commercial logistics is about providing access (i.e. availability) to a good condition product for a

PRINCIPLE/ASPECT	COMMERCIAL	MILITARY	
		PEACE	CONFLICT
Objective/Purpose	Customer Service	Sustainability	
Product Type	Generally Homogeneous	Heterogeneous	
Inventory Purpose	Buffer/Decoupler	Just-In-Case	Risk Level
Inventory Level	Minimum/Optimum	Enough	Surplus
Material Handling	Easiest and Most Convenient		
Material Handling Cost	Most Economical		Best Option
Transport	Most Economical		Most Strategically or Operationally Advantageous (Availability?)
Capital Equipment Design	Maybe	Opportunity	Essential
Methodology	Generally One Type	? Varies From Unit to Unit	Whatever is Necessary or Makes Sense
Depot Siting	Multi-Parametric - Various Reasons - Sometimes Illogical		
Maintenance	Not Applicable	Availability & Readiness (Using EMPS)	Best Turnaround Time
Medical	Not Applicable	Ambulance & Supplies	Casualty Evacuation
Organisation	Functional	Fixed Matrix	Flexible Matrix
Computers	Yes & Developing	Yes, Stand Alone	?
Communications	Adequate	Most Definitely	Best Available
Human Resources	Civilian	Military/Civilian	Military*

* Civilian technicians may be employed *behind* the front-line(s)

Table 2.3 Tabulated Results of Grounded Theory Comparison

customer by virtue of place, time and perhaps choice utility.

The choice utility concept is an inspiring one because it implies variety; and as time utility encompasses speed, putting the two together requires agility. Nayyer and Bantel (1994:193) define agility as having components of speed and variety, they (Nayyer and Bantel, 1994:194) suggest: "... that having both high speed and high variety in competitive actions would always be the most desirable competitive approach." They called this desirable competitive approach 'competitive agility' (1994:195).

Interestingly, as part of its definition of logistics, NATO (1989:19-20) states, paragraph 203(d): "acquisition or furnishing of services". Therefore, *services* appears to be a common link already. Indeed, Davis and Manrodt (1991) described the recent development of firms planning to respond with tailored services according to previously developed protocols as moving business logistics closer to the logistics practiced by the military. Logistics within the military is all about sustainability, service and response. NATO (1989:167) defines sustainability as: "The ability of a force to maintain the necessary level of combat power for the duration required to achieve its objectives." Money (1991:29) tried to define sustainability in equation form and quoted it as:-

SUSTAINABILITY = CAPABILITY x TIME

This is not strictly correct as sustainability is a function of: demography, demand, supply, time and capacity:-

i.e. sustainability = f(demography, demand, supply, time, capacity)

and furthermore it is impacted by the rate of change of supply and demand. Money (1991:29) saw sustainability as a broad canvas of which the main determinants are: equipment; manpower; and organisation. He (Money, 1991:29) said: "In terms of logistics, two of the most important consequences of the continuing trend towards the introduction of more and more advanced warfighting equipment have been a growing complexity on one hand, and a much increased volume of spares on the other". Pagonis (1992:119) in his Gulf campaign book wrote: "Sustainment of the troops in their defensive positions at the front led inevitably to the development of a network of supply depots ..." Rutherford and Brame (1993:69) in their article wrote: "... logistics must be mobile and survivable on the AirLand Battlefield. Combat service support (CSS) units must be sufficiently agile and mobile to sustain and keep pace with a heavy mechanised force. ... Finally, logistics sustainment is a "brute force" concept. The logistics community must be sufficiently robust to push anticipated requirements to manoeuvre units as fast as they need it. The pace of battle should not be constrained by a shortage of trucks, fuel or munitions." (They implied here the 'logistics drag' concept.) It is interesting that they used the word 'push' and 'anticipated requirements' together with a hint of surplus. Hayr (1991:14) said in his article: "During operations, logistic concerns cover eight main headings and a shortcoming in any could lose a battle, or even a war. Within the eight categories there are five particular commodities, or groups of

commodities. These are: food; fuels; water; munitions; war stocks - spare parts and spare assemblies. And there are the following three functions: maintenance and repair; movements and transport; and medical support."

2.3.2.2 Product Type

An industrial (manufacturing) enterprise (or its Division(s)) usually specialise in a type of product i.e. a homogeneous range. Companies generally develop within a generic product, for instance: cars (Ford, Vauxhall, Rover); textiles (Courtaulds, Viyella); earth diggers or tractors (Massey-Ferguson, JCB); white goods (Hoover, Ariston); furniture (Ercol, Gomme (i.e. G-Plan)), processed food (Heinz, Bird's Eye), polymeric household hardware (Addis), etc. Therefore, these enterprises design their logistics/physical distribution systems, plus the appropriate packaging and material handling facilities, around their generic product type and the product's characteristics together with the relevant distribution channels. Clearly, it may not be 'their' design if an enterprise contracts out its distribution (i.e. third party logistics), or indeed its purchasing (i.e. one-stop-shopping). Also, there are retailers like Boots, Tesco and Argos, etc. who carry and handle many different types of consumer goods (i.e. heterogeneous), offering customers a range, variety, choice and one stop shopping; these manifold product types can be delivered in consignments with a generic handling method like palletisation, possibly via cross-docking operations, or individually via courier or parcel post.

Commercial views on this homogeneity of product distribution is changing, as Al Graham, chairman and CEO of the Oshawa Group Ltd. (Toronto, Canada) (in Partch 1993:34) put it: "Actually, we make far more deliveries to stores now than we realize. Why not stop thinking in terms of perishable or non-perishable deliveries, cool or frozen, and perhaps mix loads with more frequent deliveries? If we want to reduce store inventories and increase turns, this might be a way."

For the military, the products handled are heterogeneous. Military logistics has to transport and handle everything: all vehicles, tanks, all aircrafts, all ships and submarines, media for communications, ammunitions, people, tents, food, clothing, hygiene and protective facilities, medicines and medical support, fuels and lubricants, repair facilities and spares, computers, batteries, etc. The transport and storage of these goods is always multi-product for three reasons. Firstly, their need. Secondly, interdiction[14], fire, terrorist attack, damage or breakdowns: if products and goods are mixed, then should attacks, fire or breakdowns occur, a little of everything is lost, but there will still be some of everything available too because of this multi-product philosophy. Hence the British Army's adoption of the "three-points dispersal" storage policy within a depot. One of Huston's (1966:661) principles of logistics was

[14] Interdiction is to destroy, cut, or damage with firepower bridges, enemy lines of reinforcement, supply, or communication - generally to destroy/disable the enemy's 'Lines of Communications' (LoCs).

'dispersion'; he wrote: "Within reasonable bounds storage and other logistical activities should be dispersed, and multiple lines of communication should be used when possible in order to minimize losses from enemy action, ease congestion of activities and transportation facilities, and draw upon multiple sources of supply. Multiple sources of procurement should be used in order to develop a broad production base which will facilitate rapid expansion and lessen the impact of mobilization in a particular area." Thirdly, 'Desired Order of Arrival of Shipping Table' (DOAST) (Addy, 1992:10-11), which is a military procedure to ensure that having flown personnel to an operation whilst shipping their heavy equipment, it is necessary to ensure loading and sailing take place in an ordered and controlled manner. By this planning, personnel will marry up with their crucial equipment and sustainment on the dockside without delay and can therefore begin training or deploying for their mission or operation.

At the early stages of the Falklands campaign DOAST was not employed as the UK Government wanted to demonstrate visibly to the Argentineans (and the world) the mobilisation effort being carried out. This was a UK government 'marketing/propaganda ploy'. By shipping vast loads of all the readily available things the message conveyed to the Argentineans was that 'real business (i.e. war)' was meant. Much effort was expended later on Ascension Island to arrange and establish the resources and facilities in an ordered usable grouping sequence (Thompson, 1991:259, 264).

2.3.2.3 Inventory Purpose

In industry the purpose of inventory is to act as a buffer or decoupler. It serves to separate two functions, operations or processes having different flow rates, in order that the downstream requirements can be satisfied from stock (i.e. the inventory buffer) as the upstream supply is insufficient. The buffer stock is then replenished via overtime, nightshift, or weekend/holiday working.

In peace time inventory has been kept by the military as 'war stocks' purely as a Just-In-Case (JIC) policy to sustain any immediate or unexpected event of a war/conflict, as Southworth (1989:Chapter 2, pp 11) pointed out: "The vast losses of stores after Suez and Aden concentrated the planners' minds to view that the only secure way of maintaining flexibility and ensuring availability was to hold large stocks in the home base." For the conflict case, inventory would allow calculated risks to be taken in battle/war according to an estimated/anticipated duration, or knowledge of the enemy's weakness or incapacity to resist. Inventory here enables opportunities to be taken and can result in a strategic advantage. The war maintenance stocks also act as a buffer whilst civilian industry, being mobilised, 'ramps-up' to continue feeding the demand of a protracted campaign. Again this is all rate of change and differing flow rates related.

2.3.2.4 Inventory Level

Industry endeavours to keep inventories to a minimum (endeavouring to reach zero inventory (Hall, 1983)), in order to: reduce the amount of capital tied-up giving better cash flow; prevent losses by obsolescence and shelf life; reduce damages that surpluses and the attendant rehandling causes; and to keep the total asset denominator as low as possible for the return on assets or investment (RoA or RoI) ratio; (see Christopher, 1985:14-22, 140-142; and 1992:59-71). Occasionally, to cover for long lead-time items or products, inventory would be held and justified. Just-In-Time[15] (JIT) systems are designed to balance flow rates throughout the functions, operations or processes thus eliminating buffer stocks. Obviously, there are times when a peak in demand is expected (i.e. seasonality) and stock would be held to service it. Also, strategically, stocks can be held purposely by not releasing them to the market in order to retain higher prices - creating an 'artificial shortage' as supplies have been controlled - diamonds being an example. Corporate policy would determine the optimum stock level philosophy and operational research techniques could be employed to calculate that optimum level.

During peace time, the military holds enough inventory. The "enough" is determined by: government policy; the expected and type of conflict scenario that it may be necessary to contend with; a defined period of sustainment; and the lead-time required to mobilise industry to sustain and support whatever action necessary. In a conflict scenario it is not unusual to have surplus of everything possible, purely to increase the chances of winning the battle/war. One of the principles of logistics concluded by Huston (1966:655-656) was: "First with the Most. The primary purpose of logistics is to deliver adequate potential or actual fire power or shock to the critical places at the critical times for achievement of tactical and strategic objectives". Pagonis (1992:210) wrote: "We in the military must sacrifice some measure of efficiency to maintain a higher margin of safety. We stockpile a little (or a lot) extra, just in case. We build a redundant system, ... just in case."

2.3.2.5 Material Handling

In all three cases of this aspect the easiest and most convenient applies (assuming the scale is a determinant). The product type and packaging, weight, bulk and quantity, the attempt to avoid accidents and damages, and facilities within the channel or chain apply as factors in the handling methods. Containerisation has helped both military and commerce with this matter, particularly with speed of handling, protection over long distances and overseas transportation (via multi-modal) as well as multi-product bulk shipments - as long as the contents are known. Multiple consignees for a single container and not knowing what was in each container, together with insufficient handling equipment provided major headaches in the Gulf conflict (Addy, 1992; Pagonis, 1992; Menarchik,

[15] Just-In-Time is a supply system that operates the philosophy of: the elimination of waste, excess and unevenness.

1993; and, Pagonis and Krause, 1992). Menarchik (1993:175) commented: "Most disconcerting was unloading capacities at the ports and movement beyond the ports." Pagonis (1992:205) wrote: "Another critical shortage was in the area of materials handling equipment (MHE), which includes forklifts, mobile cranes, and so forth. ... Equipment alone will not solve our problems in the MHE area. I, for one, am convinced that the Army has to create and maintain formal MHE companies." This points out a requirement for specialists and experts in the MHE field, presumably a call for custom/purpose designed facilities too? Huston (1966:673) alluded to similar problems in a previous campaign: "Many of the amphibious operations in the pacific were mainly Marine Corps actions, though the Army forces participated in a number of them, and the biggest amphibious assaults of all time - North Africa, Sicily, Normandy, Leyte, Luzon and Okinawa - were essentially Army operations. Congestion of shipping and getting supplies ashore and in orderly storage as needed were continuing problems. Unloading capacities at the ports and local transportation beyond the ports probably were the greatest logistical problems of World War II". The greatest logistical problem of WW2 identified by Huston and the same problem cited by Pagonis in the Gulf campaign - an interval of nearly 50 years - has indicated that lessons from history are either forgotten or not heeded. For speed and convenience of handling, the British Army uses 'flatracks' today.

For reasons mentioned above, during the Falklands campaign a similar problem of not knowing 'what was where?' occurred during the early stages of transportation, but this was caused by the government's push to move things quickly and its desire for the world - particularly the Argentineans - to note what vast quantities of resources and facilities were being deployed to defend (or retake) the islands.

2.3.2.6 Material Handling Cost

From a commercial standpoint and the military in peace, material handling costs would be managed economically concomitant with: customer demographics; capital available; product type; the unit load size; bulk; weight; quantity; handling frequency; volume throughput; customer service level; and accident avoidance, etc.

In the military conflict case, cost would not be the prime determinant. Here the best option of providing most convenience, speed and effectiveness in the material handling would be sought. Pagonis (1992:205) comments on insufficiency here during the Gulf conflict.

2.3.2.7 Transport

Again in the commercial and military peace sector, generally economy is the driving force regarding transport in pursuit of a defined customer service/satisfaction level. For instance multi-modal (like sea-air) transportation of containers (and other freight) is becoming very common. An example of reasonably priced transport (Delia-Loyle,

1992:16-17) is freight that is sent via ship from Japan to Seattle (the largest sea-air transit hub) which is then road or rail transported to Tacoma airport and then flown to destinations throughout Europe. Likewise containers/freight are sent to Miami via ship from Bremmerhaven and Hamburg (Germany) which are then transported to Miami airport for flying to destinations throughout south America (Delia-Loyle, 1992:18).

However, for the conflict scenario, the most operationally and strategically advantageous mode, type (i.e. what is available?) and speed would be desirable in an attempt to gain the upper hand (possibly by surprise) in theatre in spite of incurring high costs. Doyle (1964:103-104) argued that it was/is because northern France and Belgium were/are 'an easy military route' that they 'have been an invasions corridor for centuries'. (It is because, throughout history, more European battles/skirmishes have taken place in Belgium than any other European country, that Belgium is known, or labelled as: "the '*cockpit*' of Europe".) The analysis of the chartered shipping costs for the Gulf campaign indicated that the UK paid far too much when compared with normal market shipping rates. See Extract 2.1 for this, and other Gulf campaign logistical matters.

2.3.2.8 Capital Equipment Design

In industry, purpose/custom designed/built logistics' facilities are found such as customised pallets/stillages for pressed car body panels etc., and Universal Parcel Service (UPS) employ workstudy engineers to design the layouts of their trucks and vans for accessibility, package storage and tie-down/release ease; but these are the exception not the rule. Most companies try and buy the best 'fit' facilities that are available within a range of products which manufacturers offer: fork-lift trucks; cranes; lorries; conveyors; pipelines; etc. Alternatively, the best fit with some minor modifications to provide a better fit are pursued.

For the military, an opportunity exists during peace time to 'test and modify' as well as to seek suitable 'commercially off the shelf' (COTS) purchases. With knowledge and experience gained from active service and training manoeuvres, any deficiency or impediment of the logistics' equipment impairing effective mission completion, can be (and is) fed back to enable redesigns and upgrades/improvements/modifications to be incorporated into the equipment's specification. A methodology used for this is "Integrated Logistics Support" (ILS). According to Green (1991), ILS is to relate support to design and to use an engineering analytical approach for designing the logistics support subsystems for hardware-product acquisition. The ILS process pursues two objectives simultaneously for all capital equipment used in the military: (a) design influence to reduce operating and support costs and simplify equipment operation and maintenance; and (b) design, development, test and acquisition of support to assure satisfactory operation and readiness of the system in the field. The effectiveness of the first objective (a) reduces the demands on the second (b). ILS is crucial to the ability of a system-

The Daily Telegraph

* * * THURSDAY, MAY 26, 1994 7

MPs blame MoD for Gulf war waste

By Julie Kirkbride, Political Staff

MPs accused the Ministry of Defence yesterday of poor advance planning on the movement of equipment and stores to the Gulf after Iraq's invasion of Kuwait in 1990.

The all-party Public Accounts Committee expressed "surprise" that the complex movements involved in Operation Granby had all to be drawn up from scratch.

As a result, some items went unnecessarily by air at a cost 17 times greater than by sea; 228 aircraft cargo pallets worth £680,000 disappeared, the contents of 2,800 containers recovered after hostilities were untraced and 80 were unaccounted for.

The hasty arrangements resulted in excessive commissions paid to ship charterers — with prosecutions now being considered by the Crown Prosecution Service.

The MoD has since questioned 56 fees out of the 186 charters arranged by the Government Freight Agency at a cost of £143 million. Four brokers arranged more than 87 per cent of the charters. In 31 instances fees were paid to two or more brokers and cost at least £243,000 above the normal maximum.

The committee said: "The MoD indicated they had learned lessons from the absence of a plan for an out-of-area operation like Granby. They told us that they and Nato had now begun planning for such situations, and, with any luck, they would not again be faced with a situation quite like this of being caught without a plan."

Mr David Clark, the shadow Defence Secretary, said he was appalled at the "incompetence and gross irregularities" disclosed by the report. He said that the MoD's slackness had left it open to the "Arthur Daleys" of the shipping world.

Noting that only five British ships were chartered, he criticised the Tory belief in the free market, which had resulted in a dangerous decline in the merchant fleet.

The number of British general cargo ships available for defence purposes has fallen from 177 in 1984 to 91 in 1993, he said — "yet more evidence that the Tories can't be trusted on defence."

(Source: *The Daily Telegraph*, Thursday, 26th May 1994, page 7)

Extract 2.1 Excessive Costs for Gulf War Transportation

product to serve its intended purpose after it is acquired. An example of ILS being used today is the current mid-life update being conducted with the RAF Tornado jet aircrafts.

Correct design and effective performance of logistics' equipment is essential and vital within a conflict arena. Lives and the course of the battle's progress depend on the speedy and proficient functioning of such equipment. Demountable Rack, Offloading and Pick-Up System (DROPS) is an excellent example of a purpose designed/built military logistics facility which improved performance/efficiency by a factor of five (Addy, 1992; Swan and Fletcher, 1991; Hammick, 1992). (DROPS has been transferred to, and is being used by, the civilian/business sector.) Foss and Gander (1993) illustrate the vast array of dedicated purpose designed and built military logistics vehicles and facilities.

2.3.2.9 Material Flow Management Methodology

Most companies employ one methodology for managing the material requirements and flow across the whole company. Similarly, if appropriate for a company, each entity/division will employ one methodology across it's operations. A methodology is selected according to the characteristic match of the operations and the methodology, the volumes in question and the philosophy pursued by the company. Usually, it is one of the following:-

EBQ or EOQ	- Economic Batch/Order Quantity
ROP	- Re-Order Point
TPOP	- Time Phased Order Point (or Periodic Re-Ordering)
MRP	- Materials Requirements Planning
MRP II	- Manufacturing Resources Planning
JIT	- Just-In-Time (e.g. Kanban is one type of JIT)
OPT	- Optimised Production Technology
DRP II	- Distribution Resources Planning - (distribution version of MRP II)
LRP II	- Logistics Resources Planning - (MRPII and DRPII combined)

The situation in peace time for the military varies from unit to unit, but within the British Army there appears to be a preponderance of EOQ and ROP. However, there are examples of other methodologies being considered: Vanairsdale (1992) argues that JIT is not compatible with the operating environment of the US Army spares inventory management programme and that the US Army cannot afford to be purely efficient at the expense of the mission; whereas Klima (1993), argues that JIT inventory control can improve US Army efficiency without hindering the mission.

During a war/battle/conflict a specific methodology/system is not important; whatever is necessary or makes sense to achieve the ends (cf. whether a real conflict *or* just a peacekeeping role) is what becomes order of the day; it really does/can become 'brute force logistics' (Rutherford and Brame, 1992) in some cases/instances.

2.3.2.10 Depot Siting

For depot siting various reasons exist and the *ideal* is usually multi-parametric (and sometimes the chosen location(s) appear/are illogical). Should the depot be close to the source of raw materials versus being close to the customer versus being equidistant? Answers to the question indicate whether prominence is given to managing inbound logistics or outbound logistics, looking at the comparative costs of transporting raw materials versus finished goods and the resultant customer service factor. One facet for business is that development grants can considerably reduce the required outlay of initial capital for an organisation and the depot siting becomes a cheap investment. Any resultant increase in operating cost that may be incurred is just transferred to the customer in an increased price. However, within the UK, in and around the triangular area enclosed by the three motorways of the M1, M6 and M69 is considered to be the most central for *national* depots, from which about 95% of the UK can be reached in under five hours by road due to the accessibility, and network/links, of motorways. In September 1998, the company Viasystems announced its intentions of closing two of its factories in Scotland, at Galashiels and Selkirk because of: "... the areas' bad road links with the rest of the country". Ownership of factories/depots/warehouses/distribution centres and, increased numbers of them, swells the fixed asset base and adversely affects RoA/RoI because they increase the denominator; (see Christopher, 1985:14-22, 140-142 and 1992:59-71).

After WW2 the French purposely placed their munitions factories and defence industries in south-west France because this was a suitable distance from Germany. Should Germany decide to attack their facilities: (i) the French would have some prior warning and knowledge, and (ii) some time would be available for retaliation to be summoned to combat such an attack. It is possible/probable that the MoD's underground high explosive depot at Trecwn in South Wales, which was built/opened in 1937/1938, followed the same rationale. Today, this is somewhat feeble as long range missiles exist, but at the time the policy was sound.

Decisions for siting military depots are numerous, varied (and sometimes illogical), and governments employ socio-econo-political logic: logical threat protection as cited in the above paragraph; sites already owned which can be suitably converted (e.g. the airfields at Abingdon and South Cerney were no longer needed by the Royal Air Force (RAF), so they were taken over by the Army as logistics bases); space required; provision of employment in under-developed and depressed areas; pandering to certain lobbyists; and behavioural ploys by strong willed politicians, military and industrial lobbyists. In the future, maybe contracting-out policies will impact location decisions?

When at war, depots or marshalling sites need to be selected so that they can be defended or offer natural protection, particularly if it is necessary for them to be near the front lines. Alternatively, very safe sites can be selected at a distance and the problem of

getting supplies to the front lines has to be organised and managed. These are usually selected and conducted in accordance with laid-down military logistics doctrine. Here, good data relating to lead-times and carrying capacities are essential, particularly with regard to the type of terrain that has to be crossed and/or negotiated.

2.3.2.11 Maintenance

In industry/commerce maintenance of capital equipment is not usually a logistics function. Maintenance comes under operations/production management, who are generally the owners of the capital equipment used to convert raw materials into marketable products. However, maintenance of the transport fleet comes under the wing of logistics in most enterprises, although few conduct this in-house.

In the military, maintenance of everything (including buildings) is a logistics function. Here the objective is to sustain a state of operational readiness of all equipment, facilities and weapon systems (i.e. these have to be conserved/preserved) consistent with mission requirements. During peacetime the Equipment Maintenance Policy Statement (EMPS) indicates the levels of service, repair and availability. For conflicts/wars, repairs (and battle damages) are categorised into different levels (normally not more than five levels). The levels are categorised by "who carries out the repair/maintenance?" viz:-

- the crew
- the organisation (i.e. the Unit)
- direct support (mobile intermediate/standard tools and test equipment)
- general support (less mobile intermediate/specialised tools and test equipment)
- depot level - usually a government depot or specialised repair activity usually a contractor.

Further factors affecting the level of maintenance are:-

- unit mobility
- complexity of equipment
- modularity of equipment
- built-in-test (BIT) capability
- built-in-test-equipment (BITE)
- improved computer diagnostics
- rapid resupply of components
- personnel skills, manpower and training
- requirement for automatic test equipment (ATE) and facilities.

During a battle/war/conflict the setting up of suitable repair facilities and workshops is a logistics responsibility with the key element of minimum 'repair turnaround time'. The shortest time procedure to repair the equipment/system and return it to duty quickly is the method chosen. Modularisation of mechanical and electrical/electronic entities is a very popular method of speeding-up repairs via unit exchange and returning the faulty unit to a

base workshop to be fault-diagnosed and repaired if possible. Modular components are very fashionable among commercial original equipment manufacturers (OEMs) these days as they contribute vastly to reducing: assembly times; the number of items held/stocked; and much loss/waste of small parts/components by spillage and sloppy handling (see Tully, 1993; Baldwin and Clark, 1997).

Obviously a lot of the above features are designed-in or are part of the original specification. Reliability, availability and maintainability (RAM) are attributes which are considered at the product specification stage and ILS helps very much with this. Definitions for RAM and the whole science surrounding them are well documented by Goldman and Slattery (1977), Carter (1986) and O'Connor (1989). The military in general, and some authors (e.g. Foxton, 1994:62) use 'RAM-D', where the added 'D' is for durability

2.3.2.12 Medical

Medical support is another aspect which industry/business does not have as a logistics responsibility (Hauk, 1964:13, 17). However, it is governed by logistics principles and is a logistics function. Some specific process industries, like oil refineries and iron foundries, do have appropriate medical first aid and ambulances in their control to take care of any emergencies.

Providing medical and surgical supplies, and ambulances is a logistics responsibility and function for the military during peacetime (Hauk, 1964:17). During conflicts, it becomes logistics' responsibility to carry out all the peace time roles and set up suitable locally sited theatre surgery facilities/tents etc. Another main responsibility is 'casualty evacuation' - the removal of severely injured service persons away from the battle arena to appropriate hospitals and the necessary surgery/treatment. This is an example of 'reverse flow' that is encountered within military logistics.

2.3.2.13 Organisation

In industry logistics is a functional pillar in the organisational structure, usually including purchasing and distribution; progressive (i.e forward looking) companies also include materials management within the production shops as well. The logistics processes transmigrates all commercial functions and as such can be likened to a 'transom' or beam running through the organisation.

For the military, logistics is a matrix (but with a large span of control) organisational structure both in peace and conflict/war times, although the matrix is probably 'fixed' in peacetimes and allowed to be 'flexible' in real engagements. It has to be a matrix structure with a large span of control because of the diverse roles and functions to support the many commanders in the various missions of a conflict/war. Logistics, therefore, appears

to be the organisational nexus within both sectors.

2.3.2.14 Computers

In industry computers are being used increasingly within logistics according to the technology available and the linkages they allow. The widespread use of Electronic Data Interchange (EDI) is growing. MRP II and DRP II are common-place methodologies which are computer intensive. OPT - with all three of its material flow patterns: 'V' (few inputs processed into many derivatives); 'A' (many inputs processed for a few derivatives); and 'T' (similar inputs and processes initially, then processed into many derivatives) - is completely computerised. Almost all inventory records and transactions are computerised too. Today, according to the sector of industry, most invoices and delivery notes are computer generated, as well as many order placement requests. Software packages for scheduling and transport/delivery route planning are used widely.

The military have long since used computers, but up until recently this has been the cautious use of stand alone PC's, primarily for simulation modelling and similar complex decision making aids. The introduction of the "New Management Strategy", "Options for Change", "The Citizens' Charter", "Market Testing", "Next Steps", "Value For Money" (VFM), "Best Value" (BV) and the formation of the new "Royal Logistics Corps" in the Army is now calling for computer integration and maybe *electronic commerce* as well. Work for these is currently being conducted - project and dissertation topics of many students at RMCS Shrivenham are testimony to this. The poor asset tracking experience during the Gulf conflict accompanied with the high expenses and much double and triple handling, had spurred many awkward questions to be answered (see Extract 2.1, page 37) and their solutions to be sought - many using computers via bar-coding and global positioning system (GPS). Clearly, there are other *secret* full spectrum *defence* 'forefront of technology' computers (even *untried/untested*) systems like 'Battlefield Artillery Target Engagement System' (BATES) and many other things/aspects/ideas with, or taking, SMART approaches.

2.3.2.15 Communications

As all past commercial logistics' scholars know, the information flow is in the opposite direction to the material flow. Increasingly today, the information flow is two-way providing good command, communications and control of the logistics' function. Therefore, the systems and facilities for adequate communication need to be in place for: customers to place orders and suppliers to receive orders and provide information; customer friendly procedures coupled with good feedback; sales offices placing orders through the distribution channels to production departments; and for production departments to place raw material requests with their purchasing people. Other computer generated paperwork like: acknowledgements; advice/delivery notes; and invoices containing delivery address details and accurate product(s) details (some customers

require specially labelled products with unique part numbers etc.) are part of the communication 'placebo' (i.e. the feeling of well being) that establishes transfer of title of the goods/product. Much exists in the area of auxiliary communications, viz: car and truck cabin telephones; bar-coded inventory management; EDI; and GPS. For speed of delivery and customer service/satisfaction, concepts like 'forward logistics' are being employed - being closer to the customer/consumer/market.

For the military, communications are fundamental and during peace both commercial/civilian and military types are used. Many sophisticated techniques of intelligence gathering are employed, e.g. 'spy in space' satellites; and obviously, satellites are used for communications too. Coding for military security and ease of handling is prevalent. Modern secured radio and telephone communications are used to their fullest extent. Indeed the military has always used the best available communications during any conflict/war period; they have in many circumstances pioneered the technology which has been transferred to industry, e.g. GPS.

2.3.2.16 Other Aspects

Human resources: clearly commerce/business uses only civilian staff. The military employs both military and civilian staff during peacetimes; and principally military staff only during real campaigns - although civilian technicians can/are employed *far* behind the front-line(s), an example is the 1991 Gulf War when civilian technicians were employed for aircraft maintenance. The education and training of people in both sectors is of paramount importance for all operations to be successful and for continued improvements/enhancements and other embellishments to be generated and implemented. One of the main purposes of military logistics is the quartering of personnel, one of the origins of the word logistics mentioned at the outset of this thesis.

There are two types/kinds of packaging having separate purposes: primary packaging for marketing, conveying information, attractiveness, display method, with dispensing/decanting facility and enclosing the contents; and secondary packaging for protection, ease of handling and space efficient stacking. It could be argued that in most cases the military only requires, or needs, secondary packaging, whereas commerce/business requires/needs both.

Post/mail within the military is a logistics responsibility, not so within business, however, Royal Mail/Parcel Force are logistic businesses. There are many commercial postal/courier companies like DHL, TNT, UPS, FedEx and the Post Office whose role is purely logistics.

Another role within military logistics is the safe and socially responsible disposal of equipment at life end and redundant stock, demonstrating that the military practice

rhocrematics according to its correct definition.

2.4 Discussion

2.4.1 Integration

Integration is the lining-up of separate entities. In his article, Wheatley (1993) implied that the transfer of logistics principles has been from military to commerce. He stated: "The prominence given to logistics reflects its new importance in today's commercial world. Ten years ago, the word's connotations were largely military: logistics was all about the movement of men and materiel to the scene of conflict. It was borrowed by business because it reflected the ideas of integration that businesses were facing up to in their fight against the Japanese and others. Just as it is pointless getting troops to the battleground without their equipment, businesses started to recognise that they needed to approach their distribution in an integrated way. Instead of one function handling stock control, one handling transport and another handling the business of manufacturing or buying, with each aiming at different objectives and following different rules, logistics aims to tie all these together. By doing so, a company's stocks can be slashed - yet paradoxically, customer service and stock availability are enhanced, and costs reduced."

It is interesting to note the phrase "ideas of integration" that attracted businesses, and which implied that the military was integrated. This was not the case organisationally: from the 1st. April 1993 the UK Army amalgamated four Corps and other Units, viz:-

	Royal Army Ordnance Corps	Amalgamated into the new:- Royal Logistic Corps (RLC).
	Royal Corps of Transport	
	Royal Pioneer Corps	
	Army Catering Corps	
	Clothing and Textiles (the function)	
and	Postal & Courier Services (management of Agency)	

The reason for the formation of the new Royal Logistics Corps (RLC) was organisational 'integration' as well as efficiency and effectiveness: the Ordnance Corps used to acquire, store, preserve and administer 'things', the Transport Corps used to deliver those 'things' but there was contention about who should load/unload the 'things'? Rules were drawn up as guidance for where responsibility lay, and to clarify who had the responsibility for loading and unloading according to the dangerous nature of the 'things' in question. Interpretations were rife. Now the RLC is responsible for the acquisitions, storage and preservation, loading/unloading and transporting; this is one step closer to the recommendation made by Pagonis about MHE. Interestingly, maintenance - a military logistics function - which is carried out by the Royal Electrical

and Mechanical Engineers Corps (REME), and purchasing (the Procurement Executive (PE)) were not included in the merger, demonstrating that *full* integration is still some way off.

A noteworthy point is that the Australian defence forces have recently (circa 1990) centralised logistics properly (with a few minor exceptions) for the three Services (Army, Navy and Air-Force) resulting in total military logistics integration (Assistant Chief of the Defence Force for Logistics, 1991). Accrued cost (e.g. overheads) reductions and concentration of skills are the benefits of the economies of scale, scope and centralised facilities.

The question to pose here is whether the transfer of business logistics integration principles can help the military? Describing the mission of logistics management, Christopher (1992:12) concluded: "... there is a crucial requirement to extend the logic of integration outside the boundaries of the firm to include suppliers and customers. This is the concept of *supply chain management*.." Some companies with the same customers are investigating the possibility of sharing a common logistics asset base for their distributions, seeking both cost reductions and better utilisation rates of the asset base; some competitors are even sharing the same resources (e.g. Proctor & Gamble and Elida Gibbs share the same warehouse). This makes sense where 'economies of overheads' can be accrued. An interchange of the concepts and findings from both military and commerce would be timely.

2.4.1.1 Modelling And Scheduling

Although the initial operations research/modelling techniques developed for the military originally transferred to commercial use, subsequent commercial development in simulating the total material flow, together with some of the modern business methodologies, may now, in turn, be of some use to the present day military. One example is the possible use of OPT scheduling philosophy/methodology for the scheduling of equipment repairs, where the pursuit is availability and readiness maximisation, rather than revenue or profit maximisation.

2.4.1.2 Power In The Supply Chain/Network

Whilst power in the distribution channel was alluded to by Bucklin (1968), it is now generally recognised that within supply chains/networks a particular party 'wields' power and influence which *forces* the other linked parties to perform or behave in a particular way or fashion. The imbalance of power in a distribution channel has been commented on by Cooper and Gardner (1993:17) who described it thus: "Asymmetry reflects one firm's ability to exert power, influence, or control over another organization or its resources." They then referred to how size is the determining factor in where the power lies; Cooper and Gardner (1993:18) continued: "Large retailers can affect channel

behaviour and operations because of asymmetry." Other researches have agreed with this, for example: Hogarth-Scott and Parkinson (1993:12): "The concepts of power and dependency are central to channel relationships. Power is defined operationally as the ability of one member in the channel to control another member at a different level. ... Power is linked to position within the network, and network position provides a location of power from which to influence the network. ... Conflict is clearly associated with power, and can arise when the achievement of the goals of one organization is impeded by another."; and Wynne et al (1994) linked power to size too: " ... the ability to manage the supply chain to the retailers' optimum benefit is dependent to a very large degree upon buying muscle/economies of scale."

Technology and other factors may have a further impact with regard to the '*power-play*' as Hogarth-Scott and Parkinson (1993:17) commented: "Power/dependence, conflict and co-operation are important in all channel relationships. However, the balance of power and the level of conflict and/or co-operation is being affected by technological and structural changes in the retail marketplace." Most of the power within UK retail channels lies with the major High Street retail stores/multiples and it is these players who can afford the technology and dictate which and what technology they prefer - *implying* to the other participants of the chain/network, what they should use also. Other examples exist; the phenomenon is prevalent in Distribution and Licencing arrangements (see Shipley and Egan, 1992).

There is no doubt that from the military perspective, the power over the supply 'umbilical cord(s)' lies with the front-line, teeth-arm commander(s). When he/they make(s) demands the logistics providers 'jump', and try to make his/their edicts happen.

2.4.1.3 ILS And Terotechnology

Integrated Logistic Support (ILS) is a direct parallel of "Terotechnology" (coming from the Greek word 'terin' meaning to watch over). Terotechnology is defined in BS 3811 (1984) as:-

"A combination of management, financial, engineering, building and other practices applied to physical assets in pursuit of economic life cycle costs.[16] Its practice is concerned with the specification and design for reliability and maintainability of plant, machinery, equipment, buildings and structures with their installation, commissioning, operation, maintenance, modification and replacement and with feedback of information on design, performance and costs."[17] Terotechnology was developed as a concept by industry some twenty years ago for reviewing physical assets in terms of investment and

[16] Life cycle costs are defined as the total costs of an item throughout its life including initial, maintenance and support costs.

[17] *Glossary of Maintenance Terms in Terotechnology*, BS 3811 (British Standards Institution, 1984), no. 101.

cost. It focused attention on the gains to be made by coordinating their inter-related functions. A possible reason for terotechnology not being widely used initially was the information intensity that caused major data handling headaches.

ILS is terotechnology embellished with computer power (providing easier data handling/management) to store and cross-relate data. At the heart of ILS is the Logistic Support Analysis (LSA). Pictorial models trying to place the relationship of LSA to ILS are illustrated in Figures 2.2 and 2.3 where the individual factors and elements of design and ILS respectively are displayed. Within the project management scenario, LSA is the resultant/outcome overlap of design and ILS. However, an *ideal* to strive for is the *coincidental integration* of all three of: design; ILS; and LSA. Obviously, there are some useful engineering premises and principles to follow here that would promote the longevity of equipment and machinery like: modularity; minimising the number of parts; minimising the number of *moving* parts; and incorporating 'hot' and/or 'cold' redundancy systems; etc. It was the space exploration programme that accelerated the concept and development of ILS because spacecraft have to have a high degree of self-sufficiency coupled with aspects like double, triple, or even quadruple, redundancy.

2.4.1.4 Interdiction And Crime

An area possible for transfer is the principles and knowledge from military to commerce of combating interdiction. Industry could use some help in countering hi-jacking/theft of cargo, freight, etc. This transference is well worth investigating. Alternatively, business can use the transferred knowledge to improve their performance to counter, and win market share from, competitors.

Such is the importance of a good logistics/distribution system that drug smugglers use a JIT supply system. "Since most value in an illegal business is added in the final market, competitive advantage derives from an ability to provide continuous supply, which in turn ensures control over distribution networks. Stocks must be maintained at all points along the smuggling pipeline to minimise the effect of lost shipments. The success ... in this respect may have been a decisive factor in ... gaining control of distribution networks in America after 1989-90, ..."[18]. The concept of 'postponement' in product completion is very prevalent in this example as is the principle of 'vendor stocking'. Thompson (1991:337-340) gave some logistical examples and scenarios appertaining to guerrillas and terrorists.

2.4.1.5 Green Logistics, Disposal And Reverse Logistics (Take Back)

Giuntini (1995:57) defined reverse logistics as: "An organization's management of material resources obtained from 'customers'". A definition from Russell (1995:39) is:

[18] Taken from: "Colombia's Drugs Business - The wages of prohibition", *The Economist*, December 24th.1994 - January 6th. 1995, pp 23-26, quote from page 25

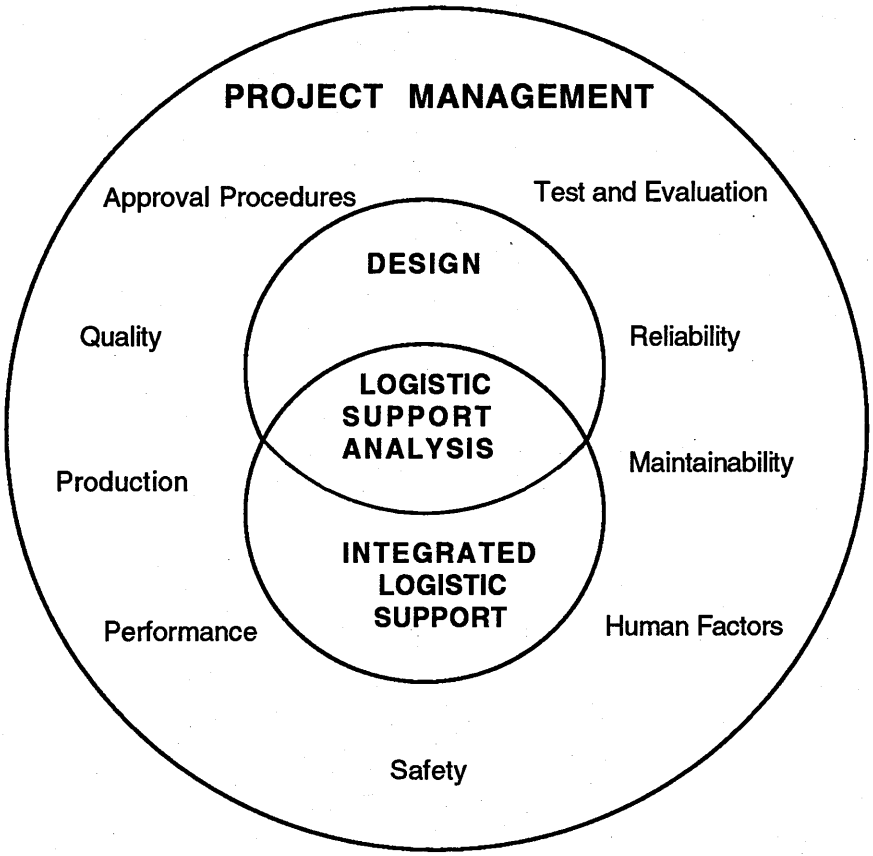


Figure 2.2 Within Project Management, LSA is the Overlap of Design and ILS

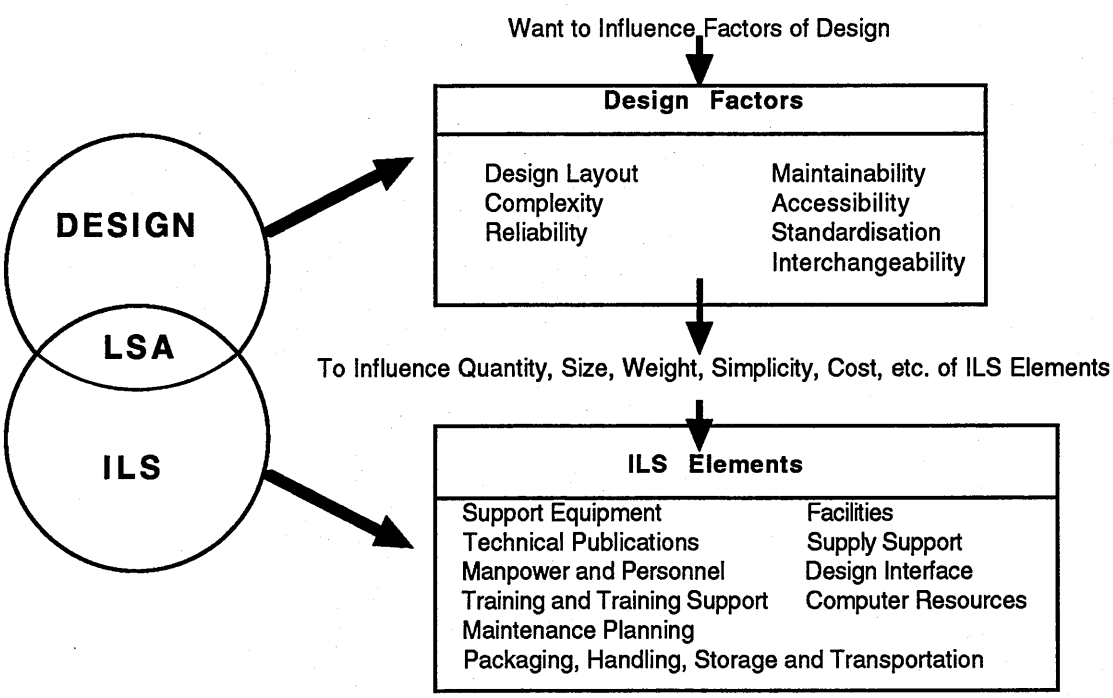


Figure 2.3 The LSA Components of Design and ILS

"Reverse logistics is defined as the recall, reuse or recycling of products." Giuntini (1995:57) saw this as: "... material resources whose material life-cycle can be extended through recycling, reclamation and reconfiguration."

The principle of collection and reuse of 'containers', like: milk, soft drink and beer glass bottles - for a domestic example; and beer barrels, pallets and stillages - for an industrial example; have been a normal way of life for some years. Returnable deposits on these containers were/are used to encourage consumers to return them. Tesco the supermarket uses this deposit principle with their plastic carrying crates that they insist (note this exertion of power) their suppliers use as a *condition* of trading/business. As Russell (1995:39) commented: "An interesting case of forced reverse logistics is the federal law in Germany that requires all exporters to Germany to take their packaging materials back out of the country." Disposable packaging is beginning to negate the need for this collection and reuse in the domestic case, but the disposal of the packaging now presents a problem. Disposal and/or replacement of polymeric and carton packaging can be environmentally un-friendly (hence the German federal law) as well as costly, and so recycling is employed. The supermarket chain Sainsbury encourage consumers to reuse their plastic carrier bags by refunding a penny for doing so; these plastic carrier bags are produced from recycled 'shrink-wrap'. A further example of reuse/recycling is Marks & Spencer (other retailers too) and Dry Cleaning outlets who reuse clothe hangers. Companies inform their customers of the recycling practices being employed in order to promote/win 'positive public perception'. These days many consumers, on a voluntary basis, take their empty bottles, used glass and cans, used papers and old clothing to one of many central collection points to be reused/recycled in the secondary raw material market. Having specific containers for each item at these central points helps because it alleviates the expensive process of 'sorting-out' - as it is done by the consumer. Scrap metal dealers also provide a recycling service for the secondary usage of metallic wares.

In Germany, a logistical network has been established by Kühne & Nagel (AG & Co) and various recycling specialists (like Reinhard Waibel KG and Flettner) for the truck/road collection of used and discarded wood and timber from many sources/places like: building/construction sites, factories, refuse sites, communal recycling facilities and scrapyards. These wood loads are taken to reprocessing plants where they are crushed into wood chips and then transported in regular whole-train consignments to the Italian chipboard industry as the valuable raw material feedstock.[19]

Recycling of machinery parts has been conducted via part-exchange schemes where a specified refund is given for the returned part towards the purchase of a new part - i.e. its replacement. The returned part is reworked or reconditioned and subsequently

[19] Source: Kühne & Nagel (AG & Co) literature: *1996 Annual Report*, pp 31; and *KN Journal*, Nov/Dec '96, Issue 31, pp 10-11

resold/reused. Examples of these are car brake-shoes, starter motors, and gear-boxes; some vacuum cleaners; some white kitchen goods motors; lawn-mowers; etc. Further principles, definitions and examples are given by Giuntini (1995) and Russell (1995:39). Reclamation is gaining popularity and it can be carried out profitably (Giuntini, 1995:58; Biddle, 1993); the above are some commercial examples in the proof of the sense in recycling being more important than disposal, preserving as it does the world's natural resources (see Cairncross, 1992). Product re-calls are a form/type of reverse logistics that have to be managed too, where products may have to be reworked, altered or adjusted, usually at the supplier's expense.

The military have been very good at the life end disposal of their equipment and waste in a socially responsible manner. In fact, in the life-cycle costing exercise of all new military projects, a budgetary allocation is provided to enable the suitable disposal of equipment/waste/by-products at its life end. (Also, if any military surplus - of a general nature - exists it is sold-off to the private sector of the economy (Hauk, 1964:12)). Operationally, when submarines go on exercises and missions, all secondary packaging of provisions are removed so that space and weight are saved as well as removing the task of their disposal during the missions. Similarly, passenger air-flights have all secondary packaging removed from the sustainment needs and duty free goods prior to their loading.

In the consumer world, 'reverse logistics' or 'Take Back' as recycling is known, needs to be made more prominent and not be a trite subject of lip-service. For example, BMW have advertised widely that the new 3 series vehicle (launched in 1994) is totally recyclable, and by German law BMW are responsible for overseeing that disposable, recycling of the vehicles at the end of their lives - in Germany. The system for doing this in Germany has been inaugurated, but they have not set-up a system for doing this everywhere outside of Germany; although in the UK a private initiative has been set-up for that purpose in Sussex, called Bolney Motor Works (notice the initials). Such is the case with most companies; only when national laws compel them to comply with a reverse logistic role will they do so. Yet, the reverse logistic responsibility taken on by a firm could win brand loyalty by consumers - a kind of enhanced product and 'Green' following support. This would be a demonstration by business that a socially responsible approach was being taken without the necessity of encapsulating legal ties.

The principles of image building and improved perception by onlookers is a trait that could be transferred to the military. A military example of this was during Operation Motorman in the late 1960s when the UK Army was deployed in Northern Ireland. A conscious decision was taken by government to remove the caterpillar tracks from military vehicles and replace them with wheels. This was a direct result of the world's impression of Russian tanks rolling into Czechoslovakia in 1968 - i.e. one of oppression.

By having wheels on the deployed tanks in Northern Ireland the intention was to portray an image of trouble curtailment and containment - not oppression. At that time the logistic problem was that no wheels were available, and their design, procurement and fitting had to be carried out with all urgency.

2.5 Conclusions

Citing Spaight (1954:237): "It is better to take logistics as embracing everything that has to be done for armed forces in the way of providing them with all their material needs and ensuring that they are in this respect ready for battle." In a military context, the various categories of logistics that must be considered in planning for a combat force capability to be sustained for a given period in/at a specified area/location are threefold:-

1) SUBSISTENCE LOGISTICS - these are the basic necessities of life; food, water, shelter, clothing and medical care. This requirement is fairly stable for a given force size and can be accurately predicted - i.e. deterministic.

2) OPERATION LOGISTICS - these are the things that get "used-up" (the consumables) during an operation - fuel, power, ammunition and people. Here again, these are fairly predictable for a given operation at a known intensity and casualty level - i.e. deterministic; but, as the campaign evolves/progresses, the delivery destinations can change (i.e. mobile points of delivery).

3) HARDWARE LOGISTICS - here is the difficult one; these are the resources necessary to keep hardware operating. Spare parts, manuals, test equipment, tools, fixtures and handling equipment, special work-shops and facilities, and trained personnel are all part of this category. This area, more than the others above, requires an effort to integrate, or "fit" all these elements together - i.e. stochastic?

Subsistence and Operation Logistics have been refined over the years to the point where their accurate prediction for a given force level is just a matter of pushing a button, i.e. computerised simulation models. For Hardware Logistics though, the equation has many more variables, and the patterns are random. Nevertheless, with a disciplined approach to analysis of logistics requirements and with proper use of statistical tools based on the mathematics of random events, a reasonable prediction of needs can be made. These predictions are being made with the mathematical tools available and further developments that are being researched.

The principal drive for the development of business logistics has been to reduce costs in the total supply chain. Most authors refer to Drucker (1962:103) as the leading proponent of reducing physical distribution costs when he commented: "Almost 50 cents of each dollar the American consumer spends for goods goes for activities that occur after the goods are made, that is after they have come in finished form off "the dry end of the machine," to use the papermaker's graphic term. This is distribution, one of the most

sadly neglected, most promising areas of American business." But, Drucker was preceded by McNair (1945:338) who commented: "In every period of high prices the cost of distribution comes under fire. Or perhaps it would be more accurate to say that a certain underlying puzzlement and distrust about distribution costs which is always present flares up during times when a rapidly rising cost of living is pinching many pocketbooks. This uneasiness about distribution costs is almost as old as recorded history. No doubt it springs primarily from the intangible nature of these costs. The country housewife taking her eggs to the local grocery store to trade for tea, coffee, and sugar never quite understands why the merchant should not allow her the full retail price of the eggs; like many another, she is unable to "see" the value added by the merchant's operations."

McNair (1945:338) continued with an example of Firestone's insistent demand for lower distribution costs with their propositions: "First: the prime need in industrial postwar planning is to develop markets - in other words, to sell more goods. Second: the next most important need is to do so at lower distributive costs, so as to reduce prices and widen markets still further. Third: development of maximum markets at lowest distributive costs will require a caliber of marketing beyond anything which has hitherto been seen in this country."

Five years later - (and twelve years before Drucker (1962)) - McNair (1950:18) commented: "It is generally estimated that not less than 50 cents of each of the consumer's $128 billion spent in 1949 on purchases at retail was required to cover distribution outlays. Of this 50 cents for distribution costs it is entirely probable that retailing, constituting the largest sector of distribution outlays, requires on an average at least 25 cents. As a matter of fact, in the case of the consumer's apparel dollar and the consumer's household furnishings dollar, something like 33 cents to 36 cents is today required to cover the retailer's gross margin, of which incidentally less than 3 cents remains for the retailer's net profit after taxes. "Does distribution cost too much?"" Following on from this McNair (1950:18) said that the right question had to be posed: "The right question is the bold one: "Does distribution cost *enough*?" In other words, is distribution doing the job it ought to be doing as part of the total American economy and is it doing it efficiently? That is the kind of question we should be asking."

It is possible that being just postwar, business/industry was too preoccupied with other matters - like restoring business and rebuilding the national economy - to pay too much heed to McNair. When Drucker made the same remarks twelve years on, the climate may have been such that business/industry was more receptive to the call for a review of distribution. Sadly, this gave much credit to Drucker, instead of McNair; however, maybe history can now be corrected.

One common nebula that is confusing modern day military and commercial logistics is the dividing line - if there is one - separating it from operations. Rutherford and Brame (1993:69) explained it thus: "Logistics operations continued even after the cease-fire. But the lessons from *Desert Shield* and *Desert Storm* were not lost in the drifting sand. First, there is an unbreakable link between operations and logistics. In truth, "operations is logistics" and "logistics is operations." Credible logistics quantify the trucks and fuel to move each combat force across the map." In the business arena where logistics is responsible for the total material supply, management and distribution, the same cries are heard. It all comes down to the word coined by Brown (1987:10) 'strategics', in essence it is the responsiveness that is crucial - both in military and business. For completeness and 'total logistics' success two more ingredients were added by Christopher (1994:20-21) who advised: "Reliability, Responsiveness and Relationships."

Research is necessary to provide a platform for the transference of logistic principles and practices between the profit generating businesses and the sustaining role of the military, particularly with regard to quick or rapid response systems (or as the Americans and the Grocery Trade call it 'efficient consumer response' (ECR)) and services. Both sectors could benefit. Industry has many differing quick response methodologies and solutions that may find a niche within the changing role of modern day forces, e.g. logistic support of counter-insurgency or peace-keeping forces as opposed to large war/battle purposes, e.g. the Allied Rapid Reaction Corps (ARRC). The logistics requirement may be one that could be 'own troop' or 'own regiment' supported, not requiring the centralised Royal Logistic Corps. It may then be possible to install an MRP II, OPT or a JIT system. As both sectors are very interested in services and 'quick response logistics systems', a view of both requirements and appropriate concepts to provide promptness and celerity would advantage all.

An example of an ultimate transfer from military to business that took place in October 1993 involved Lt. Gen. William (Gus) Pagonis - US Logistics Commander in the 1991 Gulf War - who retired from the US Army and took up the Vice Presidentship post with responsibility for Logistics at Sears Roebuck, USA. (See: Sharman, 1991 and 1991a; Pagonis, 1992; Pagonis with Cruikshank, 1992.) From anecdotal evidence, Pagonis has done well by instituting a number of military disciplines and *stimulating* the organisation. He has recently claimed that his Department/Group was going to take over (or have transferred to him from the merchandise buyers) the contracting and planning of inbound goods.

Taking rhocrematics, which includes the supply and the final disposal (which may be reuse, reclamation/recycling, recovery - or reverse logistics) then logistics really is the arteries and ***veins*** of commerce and military forces.

2.5.1 Key Modern/Current Business Logistics Principles

From all the above there are seven key modern logistics principles that appear to be the quest of the competitive companies of the 1990s. The winning companies will be striving for these principles, they are:-

- A move away from a supply push system to a demand pull system.
- Information based, not inventory based; information on requirements. (Also, this will be coupled with the attendant automated data capture and appropriate information transmission systems - predominantly, visibility throughout and 'screen-to-screen'.)
- Focus on time compression (see: Stalk, 1988; Stalk and Hout, 1990; and Drucker, 1990:98) through quick response practices.
- Seamless, end to end pipeline management; a single continuous process throughout trying to achieve the key logistical capability of 'end-to-end optimisation'.
- The 'extended enterprise' concept; closer relations with a rationalised supply base (e.g. Motorola Inc. used to have circa 1 100 suppliers; it now has circa 150).
- The 'agile supply chain/network' combining speed with variety and doing more (i.e. a higher output) with less (i.e. a reduced input).
- Flexibility (Bowersox et al, 1989:54): special customer service requests; product introductions and phase-outs; product recalls; customisation of service levels to specific markets and cutomers; and quick recovery from supply disruptions and computer breakdowns.

One other factor that will continue to be prominent and possibly made compulsory via a combination of: education, legislation/regulations, technology, taxation and pricing (e.g. valorisation and employing the 'producer pays' (and/or the 'consumer/user pays') principle) - causing serious re-thinking and re-design - will be 'green/reverse logistics'. Examples of this are: in Denmark aluminium cans are not allowed to be used for retailing liquid refreshments, and all the plastic/glass bottles/containers have a returnable high-deposit charge system to encourage their return/reuse; and from the year 2000 Switzerland is 'banning' all European through traffic (particularly the north/south routes) of heavy/large truck (i.e. road) transport thus encouraging (or forcing) them to transfer onto the rail network via 'piggy-backing' or preferably multi-modal - and possibly, if road transport is absolutely necessary, via an allocated high toll (i.e. a specific *road tax*). Debates are starting to occur around the *food-miles* issue, asking why are foods transported over long (international) distances for supermarkets when in many cases the same produce can be bought/obtained domestically/locally?

For some time now, buyers in the business to business market have indicated to their suppliers that a year-on-year unit price reduction is expected. Obviously this means seeking cost reductions throughout the whole logistics chain/channel/network from raw material (and component) purchasing/sourcing, through manufacturing/conversion, to the

physical distribution and final delivery. Naturally, wherever possible in logistics, economies of scale, improved purchasing, minimum stock-holding, better asset utilisation, increased productivity and other such cost reduction policies will continue to be prevalent and sought. Examples are: (i) the author believes that there will be a greater and more widespread use of 'draw-bar trailers' in the near future, thereby transporting approximately twice the load/bulk in one haulage with one tractor cab (i.e. minimising the 'tonne-miles'); and (ii) to help standardise European material freight movements, British industry/commerce is presently lobbying the government to increase the maximum road freight load in the UK from the current 38 tonnes to match the continental European standard of 44 tonnes. (N.B. the author has no objection to this, provided that it becomes mandatory for the higher freight load to be transported with vehicles possessing six axles - i.e. 7.33 tonnes per axle - which compares favourably with the present 7.60 tonnes per axle for the 38 tonnes which is permissible with vehicles having only five axles. However, any associated increase in 'vibration nuisance' is yet another problem unsolved.)

This chapter has laid the foundation, told the story and set the scene for the research/study of logistics that follows. However, when this study/research was initiated, and whilst collecting the data for this chapter to be compiled, there appeared to be a very strong likelihood that access to sufficient *live data* - in both the military/army and commercial/business sectors - would prove to be very difficult. From the military side, quite naturally, security and safety were the principal reasons for this; and from the commercial/business side, commercial confidentiality (or perceived competitive advantage) could not be breached. In the light of this *possible* and potential live data insufficiency, the author decided, that to continue with such a research might/would need some contingency strategy for its continuation. So, as a contingency measure, or *secondary research* for data comparison, and to provide a solid underpinning of understanding, the historical evolution of logistics in the two sectors was pursued. Therefore, the next two chapters will trace and track the historical evolution of logistics firstly from a military standpoint and then from a commercial/business standpoint.

3. THE HISTORICAL EVOLUTION OF MILITARY LOGISTICS

"Without supplies no army is brave." (1747)
King Frederick II of Prussia (1712-1786)

Following the initial inquiry conducted in the previous chapter, and with the underpinning that was gained, this chapter tracks the prompts and stimuli for military logistical advancements by listing and analysing the associated relevant aspects from: developments by certain commanders; specific wars/campaigns; a survey of the works of authors/researchers/commentators; and the technological innnovations, in a chronological historical evolution. From: a literature survey/review; some original film footage owned by the Imperial War Museum (London); and some eyewitness accounts of the more recent events/encounters, (therefore, most of the data came from secondary sources), the historical evolution of military logistics is traced. The approach adopted here was one of using *historiography* (N.B. Goodman and Kruger (1988) have demonstrated that when historiography is pursued in an 'objective manner' the outcome can be accepted as suitable data for research conclusions. In fact, their conclusion indicated the power within historiography when they commented (Goodman and Kruger, 1988:323): "The method's advantages are in variable evaluation and selection, theory construction, and hypothesis generation." However, a cautious perspicacity has to be taken when using historiography and secondary data particularly, because, in general: it has to be authenticated; its suitability as evidence supporting or refuting an interpretation needs evaluation; the knowledge of its original data collection purpose should be known and; the motive (or bias/prejudice) of the author/historian would help in avoiding: its misuse; making wrongful comparisons; and the drawing of false conclusions and/or paralogisms (Stewart and Kamins, 1993).) and *critical incidents* (Flanagan, 1954; Neuhaus, 1996) (for instance: a war/battle is a critical incident; so are heralded publications/treatises in the field of military logistics, and the introduction of certain schemes and technologies/inventions). Assessments of the stimuli and prompts for the changes in, and advancements of military logistics are made and catalogued, together with comments on the specific impacts that these have had throughout time. Also, the compiling of this chapter and the data contained herein proved a great help in: drawing together the *dimensions and variables* of military logistics (which are discussed later in Chapter 7); the *categorisation of logistics types* (discussed in Chapter 8); the process of *hypothesis generation* for this thesis (the formulation of which is displayed in Chapter 8); and the analytical *pattern matching* conducted in Chapter 11 (i.e. the analysis chapter).

3.1 Introduction

"Military history has long ignored logistics. No one wrote about and no one remembers the original logistician. He was probably a mean, but smart, Neanderthal (or earlier) warrior who spent some time thinking about his conditions and began to stock

stones, arrows, and spears in logical places for a coming battle. The chances are very good he won the battle, but we will never know since history does not tell us. Many people study the strategy and tactics of great battles but few study, and fewer learn of, the logistics actions which contributed so greatly to either success or failure in those battles." (Peppers, 1988:ii)

Before the wheel was invented 'warriors' had to carry everything themselves or use beasts of burden e.g. horses, mules, bullocks, camels, llamas, elephants and oxen. Beasts of burden could carry: people as riders; weapons; food; and other supplies (like their own fodder) upon them, or drag behind them wheelless 'stretchers or barrows' like travois which were loaded with the supplies. Panniers, slung over these animals were commonplace too. During their travels, both warrior and animal probably 'lived off the land', the terrain of which, plus its possible infertility and unfruitfulness, coupled with the loads being carried and the weather, were of considerable impediment to their advancement or journey progress. These warriors, when at home - in caves, forests, or elevated earth castles - in all probability, stocked their weapons in a kind of magazine and preferred defensive deterrents to offensive ones because of the "conditions" referred to by Peppers above. Therefore, camouflage, height, ease of protection and proximity to water were factors in selecting a suitable site for comfort and defensive logistic strategies.

The invention of the wheel must have helped to transform warfare. Not only did it allow easier transport, but bulk could be carried/transported by handcarts, barrows, horsedrawn carts, tumbrels and wagons. The militia in these cases, more than likely, were craftsmen or semi-craftsmen as well, being able to make weapons (e.g. mangonels, onagers and ballistae) from materials found, or acquired, on the way and conducting repairs to them and wagons, etc. that proved necessary, the emphasis being very much on 'the design for purpose'. One example of this craftsmanship and 'purpose designed' concept, circa 1200 BC is the 'wooden horse' of Troy; a huge wooden horse was built by the Greek warriors for the deceptive concealed mass transfer of warriors. The 'wooden horse' was left behind on the beach by the Greeks, who had pretended to give up the siege of Troy. The Trojans broke down their city wall to bring it inside. At night, the Greek warriors emerged and captured the city.

One of the greatest impediments to any army's advance in all history has been mud. Mud has slowed down armies and caused havoc in most military campaigns with the outcome of tiring and demotivating soldiers prior to any battle. Apart from animal power and human muscle, the only aid developed in an attempt to reduce the hindrance was sticks, wood branches and/or logs used in "corduroy" for walkways, bridle paths or tracks and roadways.

For crossing water, rafts, coracles (wicker covered with hide) and other small canoe

type vessels were constructed; indeed ocean going wooden ships were built too: the ancient Egyptian, Greek and Roman galleys; the Persian 'man-of-war'; large soldier/capacity carrying ships that supported the Crusades; the English 'cogs' (circa 1290) with castles fore and aft from which javelins and stones were slung; and the Spanish and Genoese carracks are examples of this. Note that the Persian 'man-of-war' was purely a fighting vessel, it was designed for manoeuvrability, speed, ease to attack/assault by 'ramming', and principally for carrying warriors and, therefore, it had very little space on board for provisions, etc. (This is another example of a 'purpose designed' facility.) Thompson (1991:17) stated: "Fighting ships were even more difficult to sustain logistically than the armies of the time."

3.2 The Early Years

3.2.1 900 BC To Alexander The Great

The Assyrians, around 900-700 BC, had two logistics' strategies: fortified cities as a defensive ploy; and timeliness when on the offensive. Harmsworth (1906:433) said of Assyria at that period: "The country was exceedingly fertile, with excellent clay for brickmaking and pottery (including tablets), and also good building stone, in the possession of which it had the advantage over Babylonia." Hence the 'building stone' - their 'advantage' - was put to good use in fortifying their cities. As Thompson (1991:10-11) stated: "At about the same time, [i.e. 700 BC] the art of fortification of the larger cities in what we now call the Middle East, had developed to a degree that their reduction had become a considerable undertaking, involving trains of battering rams, wooden towers, and plentiful supply of arrows and other missiles for protracted siege operations." So the Assyrians, with their fortified cities, were taxing - i.e. putting difficult demands upon - their opponent's or besieger's logistics. Again the besiegers had to design, and make, their equipment and missiles for purpose, i.e. battering rams, wooden towers, ladders, spears/javelins/assagais, bows and arrows with fletching, etc.

An interesting point to note, is the number of fortified cities and fortresses that were built on the coast or river banks (e.g. on peninsulas) - a ready source of water for drinking, moats and possibly fish for food. Also, they were built where forests were nearby, or accessible, so that timber was available for the building of an abattis (these were particularly popular in the Americas). These constructions at strategic locations made a siege more difficult and allowed for supplies and replenishment by sea/water should enemies besiege them. When not under siege, these waterway sites were also instrumental as 'nodes' for storage (many were built with mattamores) and processing within their owners' supply and distribution systems, as well as proving good vantage points. This follows the principle of siting facilities in, or at, strategic locations and using the terrain/geography to ones advantage.

The fertile land of Assyria provided food and grain, the surpluses being stored within the fortifications. This provides further evidence that logistics for defence was easier than logistics for offence. When on the offensive themselves, the Assyrians timed their assaults or sieges to coincide with the reaping of the harvest which meant sufficient food and fodder. Thompson (1991:11-12) referring to Assyrian campaigns wrote: "Arrival just after the harvest was the best time for the army, although not for the local population; the complete harvest was available for requisitioning. The most voracious consumers of the grain were the increasing number of animals, mainly horses and mules, but sometimes bullocks, elephants, and camels, that accompanied armies as they grew in size and sophistication."

Probably the first author to refer to military logistics was Sun Tzu (somewhere around 400-320 BC). In his strategy which advocated swiftness in the execution of war rather than prosecuting a protracted one, he wrote: "When the army engages in protracted campaigns the resources of the state will be impoverished." He continued: "The reason why a country can be impoverished by military operations is because of distant transportation; the carriage of supplies over long distances will render the people destitute." (in Hou, et al 1991:281-282). The wisdom shown here, written circa 2 300 years ago, coupled with one of the views attributed to the Greek historian, Thucydides (465-400 BC), was: "War is waged not so much with arms as with money which is the sinews of war."[20] is no less valid today - war is financially expensive, and very expensive when fighting 'out of area' - hinting that logistics was a high proportion of the expense; principally, in the earlier times referred to here, this meant food for the soldiers and fodder for the animals.

There was also the danger of transporting supplies into enemy territory - that of interdiction. Sun Tzu recognised this too: "Those adept in warfare do not require a second levy of conscripts nor more than the required supplies. The necessary military supplies are brought from home and they live by foraging on the enemy. In this way, the army will always be sufficient with food and supplies. Therefore, the wise general sees to it that his troops feed on the enemy, for one cartload of the enemy's provisions is equal to twenty of his own; and one picul[21] of the enemy's fodder to twenty piculs of his own." (in Hou, et al 1991:281)

Three important facts emerge from the above quote of Sun Tzu's: first, only the

[20] The author assumes that James A. Huston (1966) obtained the title of his acclaimed book *The Sinews of War* from this quote, although Churchill (1899:96) did use the phrase when he wrote: "Throughout the river campaigns, if the intellect of the army, if the spirit of the troops, have come from without, Egypt herself has provided the sinews of war." Winston L.S. Churchill also published a book called *The Sinews of Peace* in 1948 (Cassell & Co., London))

[21] A picul is a measure of weight used in China and the East generally, equal to 100 catties, i.e. about 133.3 lbs. avoirdupois.

necessary or *required* military supplies should be brought from home, i.e. no excess; second, the cost ratio of providing supplies etc. from home was twenty times that of acquiring them from the host (or in this case the 'hostile') nation; and third, 'fuel' for the transportation (i.e. fodder for the horses/mules/llamas/camels/oxen/elephants etc.) should not be overlooked and its cost ratio is 20:1 also.

Backing up the above points, Meinhold (1992:12) wrote: "Supplying food for the soldiers and fodder for the horses was critical to any military operation. Early armies were expected to live off the land by foraging, an activity that took time and energy from the business at hand and could be dangerous in unfriendly territory. Later, when supplies were transported along with the army, the number of days of operation were determined by the amount carried; continual replenishment was required for extended operations." This quote also brings out the question of 'what period of sustainment was possible?' When a fighting campaign was being planned, the period of sustainment was a vital issue to be addressed, for long campaigns, 'could food and fodder be supplied?' Sun Tzu's strategy of swiftness in the execution of war would appear to have been an appropriate one for his day. Another universal axiom is the practice of re-equipping oneself with serviceable captured enemy material; this has been common in every war in every generation, as Keegan (1989:103) wrote: "Supply of food, of raw materials, of finished products, of weapons themselves, lies at the root of war. From the earliest times man has gone to war to take possession of resources he lacks and, when at war, has fought to secure his means of livelihood and self-protection from his enemy."

Philip II of Macedon - the father of Alexander the Great - (circa 350 BC) insisted his troops carried their own kit and some rations, thereby releasing some of the burden requiring pack mules and wagons, etc. (Engels (1978:23, 119) revealed that 250 years later a Roman consul named Marius followed this example and his soldiers called themselves 'Marius's mules'.) Philip II also banned women from accompanying his armies thus dispensing with the children, their nourishment and baggage too. The result of these 'lighter load' edicts was improved mobility. These principles reinforced Sun Tzu's tenet that only 'the necessary military supplies' should to be brought from home.

Alexander the Great continued with his father's mobility theme. One of Alexander's strategies was to divide his huge army into smaller units so that their diminished requirements could be more easily provided during their advance through the countryside (Engels, 1978:36, 61, 72, 120) and their manoeuvrability increased. Also, in order to rid himself of a large baggage train of carts and pack animals, accompanied by drivers and other followers like forage cutters, Alexander made extensive use of ships - floating magazines - to carry provisions for the men and fodder for his horses. Engels (1978:61) concluded that Alexander never spent the winter, or even a few weeks, with his entire army in a region remote from somewhere with abundant cultivable land and an ocean

harbour or navigable river in the vicinity. Hence, many of Alexander's travelling zones and advances were littoral; naturally, bigger bulks of provisions and fodder could be carried by ships, about 400 tons (Engels, 1978:26) and fodder was not consumed by 'that' transport mode unlike pack animals that had to be fed. Progressively, as Alexander moved eastwards and away from coastlines, he used camels for transport and as carriers.

Alexander, this great leader, was also astute enough to take advantage of the logistics weakness of his enemies' warships having to land to obtain food and water. In order to conquer the Persian Empire (i.e. in essence to defeat Darius) not only was the Persian Army standing in his way, but the Persian Navy too - which controlled the eastern Mediterranean. This Navy could have easily counterattacked Macedonia back home while Alexander and his army marched off into Asia because Alexander's fleet could not match the fleet of Darius. So, Alexander proceeded to capture the entire coast of the eastern Mediterranean, from Turkey south to Egypt, thus depriving the enemy ships of their ports and rendering them powerless. This ambitious plan took several years to accomplish, but once it was achieved, Aleaxander was able to march into Asia without further concern about his flanks. As Lane Fox (1987:133) noted: "Like all warships in the ancient world, the Persians' men-of-war were like "glorified racing eights", and had so little room on board in which to store provisions that they were forced to remain in daily touch with a land base. Meals could not be cooked on the move and fresh water had to be collected by putting into a nearby river-mouth. Sharp as ever, Alexander had anticipated them and sent several units by land to beat them off. Thwarted and thirsty, the Persian crews sailed away to the island of Samos where they stocked with stores, perhaps with the help of its resident Athenians. On their return to Miletus, they still fared no better for water, and so gave up the struggle in the interests of their stomachs, and sailed away south-wards." This is a mild example of how the Persians were *cut off* and subjected to what Foxton (1994:102-106) referred to as an *Isolated Operation.*

As shown above, advance intelligence was always an essential factor in Alexander's successful operations (Engels 1978:71-2). Very often he made arrangements for the army's supplies (particularly new/fresh horses of which there was always a shortage, throughout history insufficient remounts appeared to be a constant problem) in advance with local officials, who regularly surrendered to Alexander before he entered their territory. Such was the power of his reputation for speed that it terrified his opponents. Under him, the Macedonian army became the fastest, lightest, and most mobile force in existence, capable of making lightening strikes before anyone had time to fear the event.

The first parts of the Great Wall of China (i.e. a defensive frontier) were built circa 221BC with extentions and additional turrets constructed between 202 BC to 220 AD.

3.2.2 The Roman Era

The next significant historic military logistics campaign was Hannibal. Harmsworth (1906:3017) stated: "Hannibal entered on his march to Italy with about 90,000 infantry, 12,000 cavalry, and 37 elephants. He left Carthage about the beginning of May, 218 B.C., and crossing the Pyrenees lost 20,000 men. One of the most disputed questions of ancient history is that of the pass by which he crossed the Alps; on the whole, probabilities point to the road by Mont Genevre, or the Col de l'Argentiere. Anyhow, only 20,000 of his foot and 6,000 of his horse survived to reach Italy." Only just over 22% of Hannibal's infantry and 50% of his horse survived the two mountain range crossings; no mention was made of the number of elephants that survived. It is interesting that Hannibal left Carthage in early May, that is mid-Spring, and conducted most of the journey during the Summer and early Autumn. This was probably by design, to travel during the warmest months of the year in order to increase the chances of successfully completing the journey; he actually reached Italy in early winter that same year. However, the reasons for the large losses were probably: lack of food for the men and lack of fodder for the animals; severe climatic conditions at the higher altitudes; diseases, sicknesses and illnesses; accidents of one sort or another whilst scaling the mountains; insufficient appropriate clothing and tentage; little or no medical facilities; desertion; and internal squabbles and fights. These were among the commonest reasons for the poor survival rates of the early war campaigns which involved preliminary long marches.

The Romans were renowned for their road building. Good, straight roads must have been an asset in the logistic support of any campaign or in the quick pursuit of restoring order anywhere within their empire. It is probable that the Roman roads were built primarily for logistic supply purposes, thus enabling speedy and direct delivery, and to enable fast marches. The Romans also used the central magazine principle with an arborescent divergent distribution system; for instance they used this arrangement for supplying or logistically supporting the troops guarding Hadrian's wall.

The Romans also constructed their military needs or requirements at the site of battle or war. For instance this account regarding Julius Caesar's siege of the Gaul Prince Vercingetorix at Alesia (southern France): "Thus assured of his communications being free, Caesar decided to lay siege to Alesia, which now held the soul as well as a large part of the body of the revolt. He completely invested the position, surrounding it with lines of contravallation, ten miles in perimeter and fortified with all the science of Roman field engineering, and outside these he built lines of circumvallation to protect himself from any relieving forces. These soon gathered in great force but inadequate organization, and their onsets were repulsed until, finding that Vercingetorix's sortie was equally ineffectual, they retired. The third and last attempt, made at the weakest spot - a

hill which could not be included in the lines of circumvallation - was barely withstood, but with its failure Vercingetorix was forced, from lack of supplies, to surrender."[22] Here is a rare example of a successful siege. Records exist that show, because of the advanced road construction(s) and good communications, Caesar took only 11 days to travel from Venice to Alesia with all his war materiel/equipment. The enormous task of building a contravallation of ten miles and obviously an even longer circumvallation, required much timber and possibly metal spikes. It is probable that the Roman soldiers obtained the timber by felling local trees, and the metal spikes were forged by them at the site, prior to installation. The principle of minimising the travelling distances of needed materials, and the necessity for the soldiers to have 'engineering/construction' skills, is further validated.

The Romans engaged in *standardisation* too, as this made it easier to expedite matters. For instance, at the end of a day's march, quartering could be erected quite quickly; Keegan (1993:146) proffered: "They also, in the course of their advance ... dotted the landscape with the rectangular legionary forts that their soldiers were trained to throw up at the end of each day's march in hostile territory. These standardised designs - with their four gates and central ceremonial square they strangely resemble the classical Chinese city - also formed the model for the principal Roman cities of conquest ..." These legionary forts were probably erected from a combination of localised gathered materials - a site being selected as appropriate for access to the same - and possibly some proportion of portable "flat-packed" facilities which were assembled when needed/required and neatly packed away for ease of carriage during the next stage of the advancement.

From the work of Roth (1991), in the Jewish War of 66-74 AD, the Romans foraged for fodder, firewood and water, but used supply lines to provide grain and other foodstuffs. They instituted a series of bases connected by supply lines which were used to provision the armies in the field. In his discussion of Caesar's supply system, Labisch (1975:85-86) distinguished three kinds of bases: strategic bases; operational bases; and tactical bases. Each of these represented a different kind of logistical centre used to gather and store supplies on different levels; the strategic base is best described as the source of provisions outside the area of operation itself; the operational base was specifically for an operation (e.g. campaign or battle); and the tactical base was for within the operation itself. Also, as a general rule for, or within, Roman campaigns, contributions by "allies" were more or less compulsory; allies were usually expected not only to provide supplies, but also to transport them to the army (Labisch, 1975:72).

From his tactical level revelations, Roth (1991:244-267) described the system and specific roles of certain foraging/supply offices within the Roman army, they were:-

[22] Encyclopaedia Britannica (1961) Vol. 1, pp 559

Aquatio - foraging for/supplying water;
Lignatio - foraging for/supplying firewood;
Pabulatio - foraging for/supplying animal fodder; and
Frumentatio - foraging for/supplying grain and other provisions for the soldiers.

Labisch (1975:67) imparted that collecting fodder, water and firewood were daily tasks, but a *frumentatio* required a major military operation and, when undertaken, reduced the tactical and strategic capability of the Roman army.

At the end of the first century AD, the Romans appointed *logistai* (i.e. accountants or controllers) to administer and ensure some kind of cost control and effectiveness, inventory control, and reasonably priced transport, etc. (Boardman et al, 1991:188). Defensive tactics were employed by the Romans too; in 122-128 AD Hadrian's Wall was constructed.

In 451 AD Attila the Hun with an army of nearly 750 000 soldiers strong marched on Europe, which was responsible for bringing the disease of *smallpox* into Europe.

3.3 The Middle Years

3.3.1 700 To 1850 AD

Although the Romans mounted many amphibious assaults, these were not uncommon by others, even mounted warriors charging directly from ships. For instance, one was conducted on Crete in 960, as Runyan (1993:89-90) wrote: "The troops rode their horses directly onto the beach using landing ramps. The Muslim defenders were startled by this tactic. An estimated four hundred ships took part in the maneuver, and if that is true, then several thousand horses were involved." In 1061, the Normans invaded Muslim Sicily from Calabria in *nefs* (ships of no specified type) with 440 knights and as many as 21 horses per ship. The assault on Byzantium in the Fourth Crusade (1202-1204) included unloading horses through hatches in the hulls of ships (Pryor, 1982:21). Galleys were best suited for this manoeuvre because of their shallow draught and oar power, which permitted controlled beaching. Mass transit of horses (and warriors, knights, soldiers) by ships for war purposes was a commonplace logistics affair (Hewitt, 1958; Hewitt, 1966; Pryor, 1982).

Charlemagne (Charles the Great (742-814)) King of the Franks, during his reign of 771-814, instituted a logistics system which included supply trains with sufficient food and equipment to maintain his troops for several weeks (Oman, 1898:83). Thus his troops could conduct campaigns 1 610 kilometres from the heart of France and be maintained in the field, or in sieges, even throughout the winter - which was a feat - by home nation supply/support. Also, as Thompson (1991:18) pointed out: "A key element

in his logistics system, was the use of fortified frontier posts, or burgs. These were built along the frontier of every conquered province, and connected to each other by a road. A road also led back to the old frontier from each burg. These forts were stocked with supplies, and became the bases from which the Frankish cavalry could sortie to maintain order in the conquered territory, and from which to make fresh advances." During this era the purpose built road network as a logistics aid became evident. This was almost unknown in Western Europe since the time of the Romans, nine centuries earlier.

The military heirs of the Roman empire, the Byzantines, for about 1 000 years (500-1450 AD) adopted a defensive strategy in Eastern Europe. As Thompson (1991:18-19) stated: "Except in the ninth century, when a series of great soldier Emperors led a counterattack against the Muslims, the Bulgars and the Slavs, Byzantine strategy was mainly defensive, foreign conquest being expensive in lives and treasure. They recognised that their wealth was a constant attraction to the barbarian tribes that surrounded them, and they adopted a deterrent policy, avoiding war if possible, but energetically repelling invaders, following up by punishing and harassing their aggressors with a minimum expenditure of wealth and manpower, ... By operating a defensive strategy, the Byzantine's logistic problems were simplified. ... Communications were also made easier by being on the defensive; the army was able to switch from one base to another by changing its lines of communication in a way that was more difficult in enemy territory. Thanks to their excellent military organisation, in which logistics played an indispensable part, the Byzantines were able to turn back the Muslim invasion of Christian Europe from the East in the early eighth century; ..." At about the same time, to increase his probabilities of success, Genghis Khan (circa 1190) trained his army for battle/war using hunts/hunting as military excercises and he instituted a policy whereby his warriors had to have 4 or 5 horses each, i.e. one in use and 3 or 4 remounts. By 1207 he had structured (in a decimal system) and organised his army in a manner that it could be deployed for movement (i.e. readiness and mobility) within minutes. They lived in felt tents which were easily dismantled and packed-up; each horseman had to carry his own scimitar, shield, lance, 2 bows and a quiver of 60 arrows; and his saddle-bag contained accoutrements of: cooking pots, dried meat, a water bottle, a file for sharpening arrows, and even a needle and thread. By circa 1215 Genghis Khan had a disciplined cavalry of 100 000 horsemen just prior to his advancement westward.

Before progressing further, some information concerning sieges would be helpful. Laying siege to fortresses/fortified cities was not an easy or simple option because they were static defences; Van Creveld (1992:41) concluded: "... whereas the relationship between offence and defence was such that one field army could engage another of equal size with reasonable hope of success, a numerical superiority of no less than 7:1 was thought necessary in order to besiege a strong, well-defended fortress. Therefore such an operation could only be engaged on by a large force, ..." The besieging 'large force' had

to be sustained. Many sieges failed because of the difficulty of feeding the encamped army. As Van Creveld (1992:9) wrote: "When it came to deciding just which fortress was to be besieged, or for that matter relieved, considerations of supply often played a very important role. The logistics of the age being what they were, a town whose surroundings had been thoroughly devastated might well be immune to either operation. This is well illustrated by the Dutch failure to relieve Eindhoven in 1586, a failure caused less by the difficulty of feeding a force of 10,000 men on its fifty-mile approach march to the place than by the inability to do the same when it was encamped beneath its walls. Since a really protracted siege would cause the surrounding countryside to be completely eaten up regardless of its previous state, it was only possible to conduct an operation of this kind under exceptional circumstances. Thus, Maurice during the siege of Ostend could keep his army supplied from the sea; unfortunately the garrison was able to make use of the same means, the result being that the siege lasted for a record-breaking two years."

Most authors (and past commanders) have concluded that during an operation up until this time, it was easier to feed an army on the move than when stationary or encamped; "to live, keep moving" (Thompson, 1991:11) was the general motto. Foraging and 'living off the land' was the main method of food sustainment. In 1066, the biggest amphibious landing since the Romans took place when William the Conqueror and his army landed at Pevensey (in late September well before the winter) with 300 open-top wooden boats which carried cavalry consisting of 2 000 horses. He immediately moved to Hastings to "seize rations" as a source of food existed there (Glover, 1952:3). Another interesting point is that at the time, Harold of England, was in York (to where he had marched an army of 6 000 men) and had just won the Battle of Stamford Bridge, against Harold Hardraada of Norway and his army who came to invade England with upwards of 300 ships. Fortunately, the Norwegians had left most of their armour on their ships and with the surprise attack, they had no time to fetch them. They were defeated and needed only 24 ships to carry the survivors on their return trip to Norway. Harold of England and his army then took 12-13 days to cover the 400 km or so from York to Hastings via London - a remarkable speed given a tired army (Glover, 1952:10). On the morning of 14th October 1066, the Normans attacked Harold's position on Senlac Hill. At length, by a feigned flight, William drew the English from their stockade, which was attacked on the flanks, and the position carried.

For the Hundred Years War between England and France (1337-1453) the English employed a sustainment system called 'purveyancing'; Runyan (1993:91) described it thus: "For the most part, however, supplies were gathered at home through a practice known as purveyance and transported to the army by sea. Purveyors were men sent out by the crown to purchase victuals and equipment needed for royal purposes, including military expeditions. They were appointed by letters patent explaining what they were

charged to do and the source from which payment would be made on goods purveyed. Their advantage in the marketplace was the right to buy goods in advance of competing buyers. Purveyance was never popular, and the demands on the realm were often beyond the capacity of some areas to provide." These capacity difficulties to provide were sometimes recognised and Hewitt (1966:58-59), gave the following examples: the representative of the county of Rutland attested that they could not provide the victuals assessed to them for the 1346 expedition, and an understanding crown reduced their wheat quota by half; others complained that the sheriffs, or their agents, spared the rich in purveying victuals while the poor were compelled to pay. The sheriffs did much work in identifying victuals for military use even though the purveying system was an unpopular practice, both in peacetime as well as during war, and in 1362 a statute was published which revealed the abuses/malpractices of the system of purveyancing and detailed prohibitions to be observed. (The French government had to deal with similar difficulties. The *droit de prise* led inevitably to abuses, and there were complaints over fair prices and the date of payment for goods taken.)

The English convergent supply network was designed in different regions for sustaining the war with France. Runyan (1993:92) gave this account of one such network: "The enterprise was so vast that for the 1346 campaign in Yorkshire alone ten mounted men were employed for fifteen days to purvey supplies, buy and collect victuals, and deliver tallies (promises of payment) or money to the suppliers. The supplies moved to Hull from seven collection points. Corn was ground at mills nearby, packed into eighty tuns, and moved to Hull. Seven men worked for eight days to provide the necessary transportation. Similar efforts were routine at Yarmouth, London, Dover, and Sandwich, where troops frequently gathered for the crossing to France." Merchant shipping was used for ferrying troops and supplies across the Channel and which proved to be an important logistical capacity - given the magnitude and length of the war - as no real conversion to the ships was necessary apart from setting-up stalls to hold horses.

By the time that providing food for large armies was achievable, firearms and their sustainment presented the next difficult logistics enigma. The early history of gunpowder is very obscure, but what evidence there is seems to point to China as its birthplace circa 10th century. It was probably first used in Europe as a propellant by the Moors in the 12th century, and it was used in warfare in 1346 by the English at Crecy. Harmsworth (1906:1691) wrote of Crecy: "... the scene of Edward III's victory over Philip VI of France (Aug. 26, 1346). The English army numbered 36,800; the French, about 130,000. The English loss was trifling, but that of the French has been estimated at about 30,000, including many of the nobility, blind King John of Bohemia, James, King of Majorca, and Ralph, Duke of Lorraine." The use of gunpowder by the English won the battle of Crecy in spite of being outnumbered in manpower by 3.5:1. From this period onward military logistics was about providing munitions (i.e. with its mass bulk, weight

and safety problems) as well as food and animal fodder.

Also, in the same year 1346, the earliest cannon used at sea were introduced; these were intended for firing stone balls. (However, it was not until about two centuries afterwards (i.e. circa 1550) that cannon became of much practical use at sea because ships had to be constructed differently to carry and fire cannon.) Obviously, the use of cannon and culverins (in the 16th/17th centuries), provided much power in breaking through fortified walls from a distance, and thus became essential for successful sieges. Therefore, the loading of warships with sufficient provisions and munitions prior to putting to sea and carrying out missions was paramount. An example of loading and equipping warships quickly whilst minimising the handling of goods with minimum 'material travel distance' in circa 1438 was given by Wild (1972:20) who cited Pero Tafur's book "Travels and Adventures" which contained a description of the loading of Venetian galleys thus:-

"And as one enters the gate there is a great street on either hand with the sea in the middle, and on one side are windows opening out of the houses of the arsenal, and the same on the other side, and out came a galley towed by a boat, and from the windows they handed out to them, from one the cordage, from another the bread, from another the arms, and from another the balistas and mortars, and so from all sides everything which was required, and when the galley had reached the end of the street all the men required were on board, together with the complement of oars, and she was equipped from end to end. In this manner there came out ten galleys fully armed, between the hours of three and nine. I know not how to describe what I saw there, whether in the manner of its construction or in the management of workpeople, and I do not think there is anything finer in the world."

Inference can only allow so much. Was the 'canal street' with warehouses on either side constructed as a purpose built galley provisioning facility? If so, then the designers and/or managers were very foresighted; or were the buildings and canal street situated such that someone saw the potential benefit in the use of the layout as was described?

The Spanish 'Army of Flanders' provided the next evolutionary progression in logistics by the introduction of the military *etape*[23] system. Etapes were introduced primarily because of the difficulty of finding communities large enough to quarter, feed and provide for the increase in size of army and for the frequency at which troops would be passing. A chain of etapes was set-up through Spain and France. According to Parker (1972:89) "The etape system was simple and sensible. One village was made the centre, the staple, at which the troops' food was collected and distributed. If the troops were to be given beds, the houses of the etape and of its surrounding villages could be used; those in charge of the etape together with the *furier* (the quartermaster responsible for the

[23] *Etape* is a 'staple' where food and goods were collected; a provisioning centre for troops on the march.

troops' lodgings) issued special chits, called *billets de logement*, which stipulated the number of persons and horses to be accommodated in each house. After the troops left, the householders could present the *billets* of the troops to the local tax-collector and claim their outlay against future or past tax liability." For the passages of the Spanish 'Army of Flanders' there were two types of etapes: the first was permanent and offered accommodation as well as food and - by and large - was self governing; the second was created specially for the approach of each military expedition and an officer was appointed to superintend preparations. He calculated the total quantities of food and services required and apportioned the total between various villages (Parker, 1972:91).

The etape system worked well while payments were made and tax concessions granted, but as payments became later and later, and sometimes not at all, suppliers and owners were reluctant to continue with the system. Indeed as a result of Spain continuing wars on two fronts, the defence of the Mediterranean and the suppression of the revolt in the 'Low Countries' she was declared bankrupt (Parker, 1972:235). As Parker, (1972:233) stated: "This sustained effort to fight two wars simultaneously was a crippling financial burden." Parker (1972:234) continued: "Lack of money was at the root of all these military failures. Spain could not provide the Army of Flanders with enough funds unless the defence of the Mediterranean was abandoned, and that was unthinkable. Even in 1574, the year of greatest effort, the Army's receipts were inadequate: there was not enough to pay all the troops (even the Spaniards at the siege of Leiden never received any pay), to purchase vital munitions, to organize a proper supply of food to the troops, to repay pressing debts. The price of this financial inadequacy was military failure: ..." Mutinies within the Army of Flanders were not uncommon due to the lack of supplies and pay, and the terrible conditions (enhanced by bad weather) that resulted (Parker, 1972:187).

Due to interdiction by the Dutch, preparations for the Armada's attack on England were thwarted; Parker (1972:244) wrote: "Preparations for a great fleet began in 1586. Reinforcements and larger provisions were sent to the Army of Flanders, which was to participate in the invasion project. In spring 1587 the Army moved to encampments close to the Flemish coast."

"Here the momentum of the reconquest was lost. The organisation of a food-supply to the areas newly captured by the Army had always been a problem, but it became a nightmare after 1586. The Dutch imposed a rigid blockade on the southern provinces, which prevented the arrival of any Baltic grain - the traditional stand-by of the great towns of Flanders and Brabant. This was desperately needed in the years 1587-9 because the harvest failed completely for three years in succession. The Netherlands fell prey to the worst famine of the century and there was no relief: there was no food to be had. The famine decimated the population of the provinces newly reconciled to Spain, and it carried off a large number of the troops collected for the 'enterprise of England'."

After the death of Richelieu in 1642 some Spaniards saw an opportunity to invade France. As an outcome of a Spaniard's (i.e. Don Francisco de Melo's) failure to besiege the French city of Rocroi in 1643, according to Parker (1972:261): "The French armies and the Dutch fleets cut off almost all contact between the Spanish Netherlands and the outside world by both land and sea. The supply-routes of the Army of Flanders were all ruptured." So, even if supplies were ready and available, they could not have been transported to the required destinations to be of use to the Spanish Army in Flanders.

One other contribution to the downfall of Spain's attempts to control the revolts in The Netherlands was the preferred appointments of wealthy commanders - because of Spain's financial problems - rather than those with military experience. As Parker (1972:119) wrote: "After the 1590s, however, posts of command were bestowed increasingly upon men who had seen more service in the court than in the field. The change was caused basically by the crown's urgent need for commanders who could pay for their troops as well as command them, who could supplement the king's ailing credit with their own." The 'field inexperience' of some commanders may have had a part to play in any ineffectiveness of their logistics.

3.3.1.1 The English Civil War

1642-1649 was the span of the English Civil War. The war was precipitated over who should control the national expenditure - Crown or Parliament? Both the Royalists and the Parliamentarians chose similar strategies and tactics, to spread-out their armies and not to have a defined front-line as such. There were many scattered garrisons, of varying sizes, which resulted in immense problems of control and supply. As both armies were widely dispersed they depended on local supplies/sustainment and much property, estates and horses, etc. were sequestered and/or requisitioned. The dispersion meant that neither army could inflict, or strike, a decisive blow because of a lack of force concentration. Although countless skirmishes, circa 40 battles and over 50 sieges and seizures of towns took place, only the three biggest battles were fairly well recorded, viz: the first battle, Edgehill, on 23rd October 1642; Marston Moor, on 2nd July 1644; and Naseby, on 14th June 1644. Interestingly, these three battles were fought well outside of the winter season. The principal equipment used in this war were muskets (match-lock and flint-lock), cannon, swords, pikes and in sieges *grenadoes* (i.e. crude hand grenades); also horses were needed for the cavalries.

On marches to battles, the soldiers carried a *snapsack* (a knapsack) which would contain typically: 2 lb of bread, 1 lb of meat or 1 lb of cheese, and a bottle of wine or 2 bottles of beer. As supplies and sustainment were difficult enough for themselves, so post battle each army could seldom give quarter to opponents and, it was rarely extended to those fleeing a battlefield after a defeat; the dragoons and cavalry of the victors would cut them down; no prisoners were taken. All useful equipment left on the battlefield by

the opponents would be collected and incorporated into the victor's artillery.

Scout masters were used to acquire and obtain information/intelligence about the enemy's position and strength. It is not quite known if 'gallopers' were used in the English Civil War, but at the beginning of the 18th century this was the main way of getting up-dated intelligence on a battlefield. 'Gallopers' were expert well-mounted horsemen, who would dash up to enemy formations, make a quick assessment of their strength and dispositions, and then disappear rapidly under a fusillade of shots to report back to their commanders. (For instance, the Duke of Marlborough used gallopers at the Battle of Blenheim in 1704 - this battle took place in August, one of the summer months.)

The dispersion of soldiers did have some positive effects although not directly militarily. The existence of soldiers locally ensured, via coercion, that all local taxes were paid/collected; both sides needed these funds to support the war. If taxes were not paid then the soldiers took 'free quartering' and, of course, looting was widespread as the soldiers' pay was invariably late or seldom received. At the peak of the war 1643-1645, both armies totalled 100 000 men. By the end of the war, in 1649, £3 million were owed to soldiers in wages. This was probably one of the first wars where the social impact of war was analysed. Some social historians claim that the social impact of a war varies according to the proportion of a nation's men who fight in it, the greater the proportion the greater the impact. For the English Civil War, one in four or five adult males were taken for military service - this ratio was similar for WW1 and WW2.

3.3.1.2 The American War Of Independence

At the start of the American War of Independence (1775-1783), the establishment of *Minutemen* was about *readiness*. The British army in America was unable to acquire any dependable supply of provisions locally (Bowler, 1975:239). This meant that the reliance of supplies had to be placed on the home country, i.e. Britain had to deliver across the Atlantic. This in turn made the American seaports important 'supply nodes'; the coastal waters and rivers became essential for distribution; as T.H. Williams (in Rutenburg and Allen, 1988:18) stated: "The goods in short supply were usually in the country, but they could not be got to the armies. In part the problem was transportation. Just as the British had trouble in supplying their forces if they moved away from the rivers, so did the Americans. There were few good roads ..." With reference to the supplies usually being in the country, Bowler (1975:251-252) wrote: "When the troops were actually on campaign, however, the small species were seldom issued, and as a result commissaries in America began to report, as early as 1777, embarrassingly large surpluses of these items. At times they overflowed the inadequate warehousing facilities of New York, and ships desperately needed elsewhere were detained to accommodate them. - Throughout the war the army continued to accumulate huge stocks of "small species" that, if they did

not rot first, came into use only on those occasions when supplies of bread and meat failed." There is an inference here of insufficient trans-Atlantic shipping, which is later confirmed by Bowler (1975:256): "It demanded the development of an efficient system for the reception and unloading of supply ships to ensure the quick turn-around of scarce shipping." (Prior to the start of the War of Independence, British command/supremacy of the seas/oceans was to a great extent assured because of her vast shipbuilding programme during (and to sustain) the Seven Years' War of 1756-1763 which was the first *real* world war with fighting on three continents - Europe, North America (i.e. the New World) and the Far East; at the end of which Canada became a British colony. During the Seven Years' War, 1 512 British men died in combat/action; the others lost to the navy by disease or desertion numbered 133 708 (i.e. 99%). The principal disease causing death was scurvy (or scorbutus). Just before this period of the Seven Years' war (i.e. circa 1747-1750) the Scotsman and naval surgeon/physician, James Lind, discovered that a lack of fruit and vegetables (i.e. a lack of vitamin C) in the diet caused scurvy.)

Bowler (1975:243-255) made many references to poor British administration and the fact that people appointed in charge of the supply functions on both sides of the Atlantic were appointed by patronage or privilege, and had no training in logistics or supply management. On the American side, because there was very limited industry and as Huston (1966:17) stated: "British mercantile policy, of course, had forbidden direct trade between the colonies and the non-British world.", their supplies were imported and obtained by any opportunity of seizing the British supplies by interdiction. To quote Rutenberg and Allen (1988:17): "In order to avoid British interception, most of the arms and gunpowder came to the colonies by way of the West Indies in Dutch and French ships. French ships alone provided more than 100,000 muskets to the colonies. Other means of procurement included capture of British supplies. For example, in 1775 the capture of one British ship 'supplied the Continental Army with 2,000 muskets, 100,000 flints, 30 tons of musket shot, 30,000 round shot, 11 mortar beds, and a 13 inch brass mortar'." Huston (1966:20) gave another account: "A large part of the munitions brought into the United States from abroad, and a large share of the profits of many of the most prosperous merchants were not the result of ordinary commercial transactions at all. They came from successful raids by American privateers on the high seas. No less than 365 vessels of Boston were commissioned as privateers during the war. Salem had about 180, and nearly all the New England ports had a part in privateering. Success was so immediate that insurance rates from the East Indies to England rose 23 percent in 1776. Indeed it can be said with much truth that the Americans carried on the first two years of the war largely at British expense." (It is not surprising that there was a scarcity of trans-Atlantic shipping.) Also, mass bartering was encouraged for arms, Huston (1966:17) wrote: "The state governments were advised to export agricultural products in exchange for arms and ammunition, and shipmasters were given licenses to leave port on condition that they bring back munitions."

For the American Forces, Huston (1966:23) informed us: "Probably the most critical single item for supply for American Forces in the Revolution was gunpowder." This was one of the earliest cases where food was not the principal supply problem. Gunpowder had become the most important commodity for prosecuting the Revolution. After Huston (1966:23-24) had described some of the actions taken to: set-up powder mills; import and mine ingredients, he concluded: "Even this amount was far below requirements, and frequently military operations had to be modified, and potential operations had to be left undone, because of shortages of powder." Referring to the Americans in the Saratoga campaign of 1777, Huston (1991:102) concluded: "... the Americans had developed a logistic system that - with all its specific failures, acute shortages, cumbersome administration, and difficult interstate relations - probably worked at its best during the Saratoga campaign. Major lines of communication remained open throughout. Resupply, though sometimes precarious, generally was adequate. And troops were sufficiently well equipped - particularly in the vastly superior firearm of Morgan's riflemen - to more than hold their own against the British and Germans."

In the Saratoga campaign, for his part, Lt. Gen. John Burgoyne sacrificed speed for weight which slowed him up, as Huston (1991:96) commented: "In the contest between weight and mobility, Burgoyne was sacrificing mobility. He had more men than he could feed satisfactorily with his transportation. The British commander complained that a general in America must spend twenty hours considering how to feed his army for every one that he could give to thinking about how to fight it." Remarking about Burgoyne's logistics, Huston (1991:102) concluded: "In the final analysis, it was the breakdown of Burgoyne's transportation - the failure of procurement in Canada, the failure of the corvee system, the failure of procurement or seizure en route - and the consequent delays, which gave the Americans time to reorganize, that ultimately led to Burgoyne's surrender. What he had considered to be essentials in numbers and artillery and baggage proved only to be a burden against success. On this one occasion when the British incautiously moved inland and transferred their dependence from direct support by the sea to long and difficult overland and inland waterway supply lines, they met disaster. The greatest logistic advantage that the British had at this time was command of the sea. Abandoning that advantage for a campaign through the interior, they also, by their defeat at Saratoga, brought France into the war, which ultimately would neutralize that command of the sea sufficiently to bring about the final surrender of major British forces at Yorktown."

Huston (1991:102) continued: "Burgoyne allowed logistics to become his master instead of his servant. He was so concerned with getting everything up to meet all possible contingencies that he was too paralyzed to meet any contigency. In moving his heavy ordnance and stores he lost what is one of the most important elements in warfare - timing."

Interestingly, Huston (1991:144-162) referred at length to what he called *Logistic Services* and their importance to the Americans, he catalogued three principal ones: Transportation; Engineers; and Medical Service.

3.3.1.3 The Napoleonic Period

Surrounding, and including, the Napoleonic period, many major battles or attacks/offences took place from the sea with sizeable fleets. In order to deter/resist/repel this type of invasion/attack, coastal defensive measures by way of thick walled towers were built (these towers, originally built in Italy, but were called "Martello Towers" after the one that resisted a heavy bombardment attack by the British fleet at Cape Mortella on Corsica in 1794). 103 of these towers with mounted cannon, living quarters and large storage/magazine room/space were built by the British stretching from Aldeburgh in Suffolk, southward to Seaford in Sussex, to resist and repel any potential attack by the French on England - however, Napoleon's invasion never materialised.

Napoleon concerned himself with all aspects of his campaigns particularly logistics. He, like so many before and after him, struggled with the shortage of horses (Chandler, 1966:69), they being the very essence of both cavalry and transportation. One of his goals when he was appointed General of the artillery of the army of Italy in 1794, and later in 1796 when he assumed command of the army of Italy, was to 'beef-up' the engineers in the army. Chandler (1966:70) explained it thus: "The military engineers were equally skilled under the Republic as under the *ancien regime*. Although the century-old principles of Vauban remained the basis of all fortification work (with subsequent improvements suggested by Chasseloup-Laubat, Montelambert and Lazare Carnot), the French sappers were equally adept at building roads or constructing bridges. However, with the vast expansion of French forces, experienced engineers were generally in short supply, and General Bonaparte found himself with fewer than 2,000 nominal sappers in 1796 when officially the Army of Italy should have possessed an establishment of 3,300 specialists (one company of miners and two battalions of sappers). Extemporization was accordingly the order of the day. There was a particular shortage of pontoon sections and portable boats - deficiencies aggravated by the dearth of draft horses. However, in Andreossy and Marescot the Army of Italy contained two engineers of talent with a near-genius for improvisation. Ambulance and supply formations were virtually nonexistent; the consequent shortages of medical care and provisions bred a spirit of self-reliance and creature cunning among the troops (although widespread desertion was another consequence) - and made possible the rapid strategic movements that so bewildered their convoy-minded and depot-bound opponents. All in all, therefore, General Bonaparte inherited a redoubtable weapon, ready to hand." Engineering works like making cannon lighter and standardising field artillery into three main categories were commonplace as was the creation of factories and foundries for the production of arms (Chandler, 1966:138fn, 143fn).

In May 1800, Napoleon crossed the alps with some 60 000 men and won the battle of Marengo to regain northern Italy. The researches of Glover (1957:91) revealed the following: "... Bonaparte concerned himself with every facet of the supply and transport problems. As early as 18 February he had been calculating that 2,000 mules could carry 8 days' rations for 50,000 men. On 1 March he ordered the collection of 1,500,000 rations of biscuit, 100,000 pints of brandy, 100,000 bales of hay, 2,000,000 rounds of small arms ammunition and 5,000 rounds of artillery ammunition at Geneva, a park of 1,000 bullocks at Bourg and the purchase or requisition of 2,000 mules from throughout France. On 24 April he points to the convenience of the lake of Geneva's shipping as one of the prime reasons for using the St. Bernard pass, and on the same day he orders stores to be ferried from Geneva to Villeneuve at the south-east end of the lake. On 2 May he orders more supplies to be dumped beyond Villeneuve, at St. Pierre and "un village entre St. Pierre et le pied de Saint Bernard." Hospitals are to be established there also. Later again he is requisitioning another 400 mules from the Swiss and the Valais."

Such was the logistic planning skill of Napoleon that he considered, and tried to match the appropriate supply system to the demands that were being made. He therefore used most alternatives including the *etape* system as Parker (1972:88) pointed out: "Even Napoleon used *etapes* to provision his armies on certain occasions, although he preferred to arrange permanent magazines." Thompson (1991:27) agreed with this conclusion, as he wrote: "Although Napoleon was able to take advantage of the better road system that was beginning to be constructed in Europe by the end of the eighteenth century, and an increasing population density and thus a greater ability to support armies, he still held to the methods of his predecessors, a combination of magazines to stock supplies, and foraging." A few years later, reorganisation of the army was implemented in order to deal with the inadequacies and shortfalls of the sustainment capability, as Chandler (1966:366-367) commented: "Supply and logistical support was one of the least efficient branches of the Imperial Army. In the interests of mobility and self-dependence, the needs to "live off the countryside" and to "make war support war" were constantly reiterated. Originally, the provision of supplies was entrusted to civilian contractors, but these proved so fraudulent and inefficient that Napoleon replaced them with carefully picked intendants, one being appointed for each rear-support area. In 1809 he also introduced nine battalions of supply-train troops, responsible for the establishment of forward depots, convoys and front-line distribution, and in 1812 these were augmented to a total of 22 formations, but at best they provided a mediocre service. This was not through any lack of application on the part of the commissaries and their assistants. The poor condition of most European roads (especially those east of the Niemen and south of the Pyrenees) and customary rapid rate of advance of the formations of the *Grande Armee* made it virtually impossible for the bulky and slow-moving wagon trains to keep up. For most campaigns, Napoleon restricted the amount of supplies carried in the supply trains to between four and seven days' rations of flour and biscuit, intending that

these stores should be issued only when the army was in close proximity to the foe, a circumstance which precluded any possibility of the men foraging themselves in the normal manner. Faced by the largely barren and uninhabited wastes of Russia in 1812, the Emperor attempted to improvise a more comprehensive supply system relying on flotillas of river boats as well as wagon convoys for the movement of vast quantities of supplies from Danzig and Konigsberg to the front. These arrangements, however, soon broke down, and the army that travelled to Moscow marched on largely empty stomachs."

The march on Moscow was disastrous, and it was true that two campaigns were being fought (the other was with Spain), but as Van Creveld (1992:70) summed-up:
"That the *Grande Armee* suffered enormous losses during its march to Moscow is true, as is the fact that hunger and its consequences - desertion and disease - played a large part in causing these losses. It would, however, be unwise to attribute this solely to the problems of supply. The need to protect enormously long lines of communication and to leave garrisons behind, and the effect of distance *per se* were also factors of major importance. As regards the army's material losses, there is reason to believe that much if not most of the equipment abandoned on the way to Moscow was later retrieved. In 1812 Napoleon's main force marched 600 miles, fought two major battles (at Smolensk and at Borodino) on the way, and still had a third of their number left entering Moscow. In 1870, as in 1914, the Germans, operating over incomparably smaller distances, in very rich country and supported by a supply organization that became the model for all subsequent conquerors, reached Paris and the Marne respectively with only about half of their effectiveness. Compared with these performances, excellent as they were, the French Army of 1812, for all its supposedly worthless service of supply, did not do too badly."

During the Peninsula War of 1808-1814, the British troops secured their needs locally and from Britain, both via the 'contract system'. This system worked well for the British commander - Sir Arthur Wellesley (later Duke of Wellington) - who readily pointed out early on that British troops there were operating in friendly territory (i.e. Portugal and later anti-French Spain); and moreover with command of the sea the British could move supplies with ease a comparatively short distance across the bay of Biscay from England (Sweetman, 1984:49). In October 1810 when the British were not doing too well, Wellington deliberately fell back to Torres Vedras which shortened his lines of communications, which were supplied through the port of Lisbon. By doing so, he increased the range that the French would have to achieve to reach him. This is a classic example of how an army withdraws to a natural defensive position, shortening its own overland lines of communication and supply, but conversely, the advancing enemy army finds its lines of communication and supply becoming longer (i.e. stretched) and more tenuous, thus weakening its fighting power and strength.

To pay for the local purchases and 'contracts' in Spain and Portugal, the British government just sent Sir Arthur Wellesley money. With such purchasing power, he always took care to organise *a market* and ensured that he had a choice (i.e. competition) to pick the best *value for money* (VFM), (Keegan, 1989:134).

Due to the failure of the Russian intendant general to abide with the "Russian Administrative Regulations of 1812", which was to use 'requisitions, purchase and contracts to exploit the resources of occupied countries for the army's benefit, while only resorting to our own stocks ... in special cases', 'much suffering' took place during their campaigns of 1828-1829 (against Turkey) and 1831 (in Poland). So, the Russians in 1846 introduced 'ambulant magazines' together with trains of field bakeries and butcheries. Sensibly, to minimise health and mobility issues, according to Perjes (1970:19) the common rule for 17th century armies was to collect four or five days' provisions at a time, because to collect more was impractical, due to preservation and transportation problems. However, de Roginat (1816), who scathingly criticised Napoleon's administrative arrangements, viewed strategic penetration into the enemy's country was all very well as long as it was carried out by small armies and, suggested a methodical, step by step, system of warfare advocating eight days' provisions to be the maximum (in Van Creveld, 1977:75-76).

During the Napoleonic period, the British Navy spent much of its time intercepting ships at sea that were carrying black slaves, contraband and conducting other smuggling activities for commercial gain (e.g. much of Horatio Nelson's early navy career was taken-up by this kind of policing activity and other low-key skirmishes/small scale encounters). Lime juice was introduced into the British Navy early in the 19th century as the first efficient and economic preventive agent against scurvy.

In 1830 Baron Henri Jomini published his book *"Precis de l'Art de la Guerre"* (*Summary of the Art of War*).

3.3.1.4 The Emergence Of The Railways And Steamships

The advent of the steam engine revolutionised transportation. During the late 1820s railway structures/systems/networks were developed and, it was a German economist Friedrich List who, in the 1830s, forsaw that a well conceived railway network might be useful to the military as it enabled troops to be shifted rapidly from one point to another hundreds of miles apart, thus combining numbers (force size) with velocity, thereby empowering them to concentrate, first against one enemy, then against another (Van Creveld, 1977:82). However, it was the Russians who first grasped the full potential of railways in a military context: in 1846, they moved a corps of 14 500 men, together with all its horses, accoutrements and transport, 200 miles from Hradisch to Cracow in two days. Soon after this, four years later (i.e. 1850), the Austrians moved 75 000 men from

Hungary and Vienna to Bohemia by rail which helped to bring about the Prussian capitulation of Olmutz, although at first the Prussians resisted, and opposed, the idea of railways for military transport. From 16th April to 15th July 1859, the French startled the world with an object lesson in the strategic use of railways by transporting 604 381 men and 129 227 horses by using all of the French railway tracks then in existence, of whom 227 649 men and 36 357 horses went directly to the theatre of operations in Italy (Van Creveld, 1977:82).

As Thompson (1991:36) pointed out, both the Austro-Prussian and the Franco-Prussian wars have been called 'Railway Wars'. Railways were not the complete solution as they had shortcomings, as Thompson (1991:32) explained: "Soldiers cannot fight from the train; once they detrain, their movement is at a foot pace. The lines, which take a long time to build, may not run in the direction the general would like. Once the railhead is reached, which may be miles from the area of operations, supplies must be transferred to wagons, in those days drawn by horses or mules which consumed forage, and might take days to reach the army, particularly if it was advancing away from the railhead." Faster mass transit of troops and military equipment (i.e. swift mobilisation) became a reality and the logistics of warfare improved somewhat. The pace of warfare, to some extent, could now be controlled.

Although steam engines were used in ships since circa 1802, in 1853 high-pressure steam was introduced into the British navy; but it was not until 1860 that the *Victoria* was fitted with engines working with such steam pressures as 22 lbs/in^2. Ports had to be set-up around the world with coal stocks for the refuelling of steam-ships. With the object of reducing the consumption of coal, the steam frigate *Constance* was fitted with six cylinders, thus being the earliest example of a warship with a compound engine. The arrangement, however, was not very successful, and no marked improvement was effected until 1865, when the *Pallas* was launched, with two cylinders instead of six, one being four times larger than the other, thus capable of handling steam pressures of 60 lbs/in^2 now. The success of this ship caused the general adoption of compound engines throughout the fleet.

In 1843 Karl von Clausewitz's book *"Vom Krieg"* (*On War*) was published.

3.4 The Last 150 Years

3.4.1 The Crimean War 1854-1856

The most probable reason for the Crimean War was a logistical one. The Europeans' perception was that the Russians had designs on conquering Turkey in order to have Constantinople in their control. The control of Constantinople meant the strategic control

of the 30 km long Bosphorus Strait, which links the Black Sea to the Sea of Marmara and beyond to the Aegean and Mediterranean Seas. The Europeans wanted to deny this control to the Russians and thereby curtail Russian naval activity in those regions.

At the outset of this war, the French had a permanent Army (which had been fighting in Algeria since 1830), the British did not. The French army had experienced and mature officers, the British had young inexperienced officers. Prior to landing on the Crimean peninsula, the British and French forces landed at Varna with the intention of assisting the Turks to resist the Russian siege of Silistra. However, due to the intervention of the Austrians, the Russians retreated and the aid of the allies was not needed. Whilst taking stock of the situation and considering the next stage/move, the allies camped outside Varna. In a period of two months, 10 000 men (i.e. 16.5% of the total force) died without a shot being fired; they died from the disease cholera. When the decision was taken to invest Sevastopol (a seaport fortress of immense strength), the allies sailed across the Black Sea and landed north of Sevastopol at Kalamita Bay. The chaotic unloading of the ships and the general disorganisation resulted in gross inefficiency of the whole event. On their way to Sevastopol, the Battle of Alma was fought, after which it was decided to lay siege to Sevastopol and to bring the heavy artillery in from ports that were south of Sevastopol.

This war cruelly exposed the dangers of relying upon the existing contract system, as it broke down completely. This was summed-up by Sweetman (1984:45): "... "waggons of the country" and supplies from the theatre of war lost their last shred of credibility, when action took place on a sparsely-populated Tartar peninsula. In accordance with past practice, once the expedition had been agreed the Treasury sent instructions to Commissariat stations in the Mediterranean area, such as Malta and Corfu, to gather supplies and land transport. In March Mr. Calvert, "our excellent consul at the Dardanelles", listed details of supplies in Turkey and, "seven or eight days" before British troops arrived at Gallipoli, Assistant Commissary-General Smith "actually signed contracts with Turkish individuals ... for a supply of every requisite for the army." Contracts were placed throughout Asia Minor, in Malta, Spain and at Trieste for a variety of requirements, including cattle, baggage animals and forage. Yet little over a month after the allies reached Turkey and before they advanced south of the Balkans, Smith admitted a scarcity of supplies in the field: and in Bulgaria Sir George Brown pointed out that the quality and quantity of bread depended upon the expertise and honesty of individual contractors."

The Crimean War drew attention to the problems created by civilian commissaries attached to, but not under the command of, military officers. The British system neither concentrated transport and supply in one organisation nor exclusively in military hands, but in two entirely separate departments: the Commissariat and Ordnance. The former

was wholly civilian and controlled by the Treasury; the latter, although largely manned by civilian personnel, came under the military officer who also commanded Ordnance troops. This organisational flaw was constantly being criticised together with open traducements (and 'bad-mouthed' exchanges) between the two parties throughout the war (Sweetman, 1984:41-76; Hibbert, 1985:205-218).

The Russians feared a sea attack on Sevastopol by the Allies. So, to deter this possibility, they sank (i.e. scuttled) their own fleet in a line across the mouth of the creek leading to Sevastopol, thus forming an impervious barrage denying access to the Allies' naval potential. Naturally, the barrage was formed well outside the range of the Allies' naval guns/artillery.

The war had started with Lord Raglan (formerly Baron Fitzroy James Henry Somerset) as the British General and leader, and Jacques Leroy de St. Arnaud as the French Marshal and leader. After the battle of the Alma (i.e. 20th September 1854), when St. Arnaud died, Francois Certain Canrobert became the French Marshal. Canrobert and Raglan never got on together, (probably due to Raglan's hatred for the French which was carried over from his fighting them in the Peninsula War with Sir Arthur Wellesley and because he lost his right arm fighting them at the Battle of Waterloo). Raglan would not talk to Canrobert directly; even if they were in the same room/cabin/tent, he always spoke through a third party. This poor relationship and lack of cooperation contributed to the British enduring more hardships than the French. Both the French and the British supplies (which were kept separate from each other) were brought to the Crimean peninsula by sea to the ports of Kamiesch and Balaclava respectively. The French had the better and more spacious harbour and wharf at Kamiesch, leaving the British with the other smaller, narrower, cramped and more awkward harbour and wharf (involving much double and triple handling with very little storage space) at Balaclava. Kamiesch was half the distance from Sevastopol compared to Balaclava and, it had a gentler slope access, leaving the British with an access/climb that was much steeper and twice the distance to haul artillery and supplies. (However, it must be recognised/remembered that the size of the French Army was 3-4 times that of the British Army and it may have been that *logic* itself allocated the ports this way.)

As a comparison of the advantage the French had, contrast the magnitude difference in the resultant field engineering as quoted by Strachan (1990:215): "Trench warfare was therefore the dominant military experience of the Crimea. The frontage of the allied lines was 7 miles, that of the Russians 5 miles. There were 12 miles of British trenches; and to construct them 38,894 shovels, 13,322 pickaxes, 9,319 spades, and 529,587 sandbags were brought up to Balaclava between 10 February and 8 September 1855. The French constructed 50 miles of trenches, using 14,000 tons of engineering materials, including 80,000 gabions, 60,000 fascines, and a million sandbags."

Balaclava acted as the theatre's initial marshalling area for the British and it is no surprise that that was why the Russians mounted their attack on the port, for if they could have captured Balaclava, then the British supplies would have to have been shipped elsewhere, probably incurring much longer cross-land distances. The Crimean terrain was one of steep up-lands and shipping supplies into another port, other than Balaclava, could have presented problems worse than those of Balaclava. The battle for Balaclava was a cavalry engagement, of which the charge of the Light Brigade is probably the most notable and famous. The reason for giving the order to charge was because the Russians were collecting the heavy artillery left by the Turks who had retreated. The intended order was to charge and retrieve the Turkish artillery, but the message/order was misinterpreted and the Russian guns were charged instead. When the Light Brigade had been driven out of the 'Valley of Death' where 110 men and 362 horses were killed by the Russian artillery, according to Seaton (1985:154): "... the first to recover were the Cossacks, and, true to their nature, they set themselves to the task in hand - rounding up riderless English horses and offering them for sale." The importance of horses and artillery and their currency was evident. The extent of the disaster of this charge at Balaclava was a myth as Colin Frederick Campbell - a Major of the 46th Foot - commented (in Kerr, 1997:71): "The actual loss to the army of the Light Cavalry was not so important as has been imagined, as many horses would have died of starvation if they had not been killed then; and as for the men, we bury three times the number every week and think nothing of it."

The planning, coordination, sequencing and transportation of supplies by the British were chaotic, there was a lack of any logistics system which was further impaired by bureaucracy; Hibbert (1985:205-218) gave some very descriptive examples. Hibbert (1985:206) "Ships arrived without notice in the congested harbour at Balaclava, and no one was quite sure what was in them. Sometimes they went all the way back across the Black Sea to Constantinople without being unloaded, and when they arrived there Boxer [an Admiral] sent them back again. He seemed not to know how many ships he had available or even where they could refuel. He said no transport was available when ships were lying idle in his own docks. He kept no records. ... For days, for weeks on end, ships lay outside Balaclava waiting to come in and unload." Hibbert (1985:207): "On the quayside the muddle was grotesque. Heaps of charcoal were piled on top of split sacks from which the flour poured out in damp lumps; bales of clothing were used as stepping-stones through the mud; broken boxes, rotting meat, cases of ammunition, thousands of tent-pegs, bits of wooden huts, were dumped together higgledy-piggledy in stores or in the streets. Men sat smoking on powder barrels. The stench was nauseating. Rats and pariah dogs scampered everywhere. Turkish soldiers, ill and starving, fell down and died in the street. ... Into this nightmarish town officers and men came down to entreat and bully, threaten and plead with the commissariat officials, who, despite the vertiginous muddle into which they had been plunged, tried to deal with each request according to the

regulations of the Service and the system in which they had been meticulously trained." The supply problem was further hampered by the severe storms of 14th. and 15th. November 1854 when in and around the harbours of Balaclava and Kamiesch, 21 British ships and 14 French ships sank. For the British, these ships had most of the supplies in readiness for the coming winter: warm clothing, medical facilities and supplies as well as much ammuniton were lost. However, what supplies were on the wharves at Balaclava - and there were some - had no transportation to forward them anyway. During that winter, which was very severe, many soldiers in the trenches suffered and, lost limbs from frost-bite. As it was the worst Crimean winter for many years, the Russians saw it as their ally in deterring the progress of, and causing much distress to, the Allies.

Kadikoi, which was about a mile from the Balaclava wharf, acted as an intermediate staging post (i.e. the distribution point for supplies (Sweetman, 1984:47)). To aid the movement of supplies from Balaclava to Kadikoi the British, in February 1855, built a railway connecting the two (and susequently extended it to the British camp closer to Sevastopol). Once the siege had commenced, supplies were then transferred to Sevastopol - a further 5-6 miles from Kadikoi - by wagons, carts, horses and mules. For this final journey, the two greatest impediments to the movement of supplies were mud and cold wet weather. By July 1855 provisions were plentiful and these could be transported easily; however, the sweltering heat of the summer of 1855 presented its own new problems.

Interestingly, for the Russians, the "ambulant magazines" and associated arrangements introduced in 1846 did not prove themselves in this war, with the result of innumerable carcasses of men and horses lining the routes to Bulgaria and Sevastopol (Van Creveld, 1977:77). In the early stages of the siege the British and the French never cut-off the Russian support and supply lines to Sevastopol. These came from the heartland of Russia by large open boats via the River Don, across the Sea of Azov into the seaport fortress of Kertch at the east extremity of the Crimean peninsula and finally on land across to Sevastopol. After the winter, in late May 1855, the Allies severed this route by mounting an amphibious attack on Kertch and the sister port of Yenikale in the Straits of Kertch. The Russians, realising that the Allied attacks could not be blocked, blew-up their own arsenals and powder cellars to prevent their being used by the enemies. The large foundry, bullet factory and associated machinery found in Kertch were destroyed by the Allies and the buildings were burnt (Kerr, 1997:128). This interdiction did not take long to have an effect on Sevastopol, for instance: enemy bullets which had been collected could be handed in to the Admiralty in return for money (Kerr, 1997:120); and as one besieged Lieutenant-Captain Pyotr Lesli (in Kerr, 1997:133) wrote: "The saddest thing of all was that to every one of our shots, they would answer with ten. Our factories could not keep up with manufacturing the amount of ammunition that we required in order to do at least some harm to the enemy; and moreover, transport

on carts was much more cumbersome than by steamship which is the method the Allies used to bring them everything." Also, the Russian interns became frustrated at their commanders' passivity when their supply lines were severed, as Schultz - a Russian officer - (in Kerr, 1997:138) recorded: "This entire, unsurpassed army of ours watches quite calmly as the enemy, before our very eyes, digs itself deeper and deeper into our land, even cultivating its own vegetable gardens, cutting hay in the Baidar valley, chopping down forests and grazing cattle (while we pay twice the normal price for forage); it is even building barracks, and has taken command of Kertch, Yenikale and other coastal towns wielding its power there at will. While we, on the other hand, blow up our own batteries and powder-stores, destroy our reserves and sink our own ships."

Referring to the siege of Sevastopol, Harmsworth (1906:1707) stated: "The siege continued for nearly a twelve-month, and was terminated by the capture of Malakoff Fort, the key to the Russian position, by the French (Sept. 8). This practically concluded the war, and peace was signed at Paris (March 1856), Russia abandoning all her claims. The long siege was productive of the most dreadful hardships to the besiegers. Famine and disease swept away thousands, and twelve per cent. only of the twenty thousand victims in our [i.e. British] forces fell before the Russians. The terrible sufferings of our soldiers were in part mitigated by the generous enthusiasm of Florence Nightingale, to whom was due the organisation of proper nursing in military hospitals." The necessary impetus for appropriate medical needs for war victims, both from combat and diseases, was finally acknowledged and the Jamaican trained Mary Seacole, played an important *field medical* role too. Interestingly, neither was British trained. Nightingale trained at the Protestant Deaconesses' Institute at Kaiserswerth in Germany, and subsequently studied French methods in Paris. She, with her squad of 38 nurses, at Scutari in Turkey (to where the sick and injured soldiers had to be ferried, which took 3-4 days), did much to establish what must have been the paragon of a military hospital of the day. She was the author of a private report to the government on the Army Medical Corps and its work in the Crimea. Her main recommendations were to do with improving administration.

Realising that without supplies the siege would be successful, the Russians in Sevastopol constructed a pontoon bridge across the creek as an escape route linking the south to the north side. When the point arrived where the fortifications were excessively damaged and too weak and could not be repaired, the order was given to evacuate across the pontoon bridge. Once the Allies had secured access to Sevastopol, they destroyed the shipyards and dry-docks so that they could never be reused again without massive investment.

The Crimean War has been described as the first "modern" war, as Strachan (1990:214) wrote: "Steamships supported the allied armies; the telegraph linked them to their capitals; railways were constructed between the base at Balaclava and the forward

positions. Ultimately the efficiency of these communications allowed Britain and France to apply their superior economic strength to the theater of operations, and so exhaust the Russians into abandoning Sebastopol and conceding defeat. The Crimean War, although not a particularly long war, was a war of attrition. The great battles decided little, if anything. It was the continuation of the campaign that brought victory." This war caused the British government to review its military logistics. They studied in detail the French (i.e. heavy reliance on magazines; a defined transport corps "Corps du Train des Equipages Militaires" of six squadrons; and their constant state of preparation for war) and Austrian methods of the day (Sweetman, 1984:52-54). One outcome was the removal of responsibility for provision of land transport from the Commissariat and the establishment for this purpose of a military organisation, the Land Transport Corps (afterwards renamed the Military Train). An inescapable fact during the winter of 1854-5 was that, as men went hungry in the trenches before Sevastopol, ample supplies lay near jetties at Balaclava; there were no means to get them to the front-lines.

The cost of the Crimean War to the British was £70 million (at 1855's value), although, later this figure was revised to be closer to £75 million. The British government had to raise half of this amount by loan(s) and thus it scuppered William Ewart Gladstone's plans to reduce income tax (Meredith, 1958:327).

3.4.2 The American Civil War 1861-1865

Following the Mexican War of 1846-1847 (where the United States faced problems with transportation, long distances, disease - yellow fever, and due to a variety of personal weapons - a *variety* of ammunition (Huston, 1966:129)), the United States had reduced the military and its capability in an attempt to cut public spending. Part of the problem was that no such thing as systematic war planning existed within the War Department prior to the Civil War (Huston, 1966:171) and, therefore, no logistics planning existed either. However, at the outbreak of the Civil War there was a general sense of its being a short war due to the industry and military hard-ware strength being in the hands of the North. The North was largely a manufacturing community; the South was almost entirely agricultural. The North had almost entire control of the military and naval resources of the country. The United States government retained possession of whatever there was of organised preparation for war. It is hardly surprising that it was the popular belief of Northerners that Secession would be crushed in ninety days (Wood and Edmonds, 1905:24).

The magnitude of the war became very evident, Denney (1994:16) wrote: "Both armies were disadvantaged by the use of long wagon trains carrying war materiel. Grant's trains leaving the wilderness were more than 25 miles long, and they moved extremely slowly." The railroad was to play a significant role in the Civil War, Denney

(1994:16-17): "Railroads were used for the first time tactically (for the movement of troops to a battle) and strategically (such as Sherman's movement of supply bases forward to support his Atlanta campaign). This was done at a very high cost in manpower to guard the railroad lines from guerilla or other attack. ... In 1860 the South had about 8 500 miles of track (over 1 700 of these were in Virginia) compared to over 22 000 miles in the North. ... Many of the Southern tracks were of different gauge (the measured distance between the rails) and this meant changing trains often during a journey. ... The North used a common gauge of track ... and had many more connecting lines between major railroad trunks. ... The concept of bringing all tracks into a common "union" station had not been developed." Turner (1953:44) agreed with the above points; primarily for the South the multiplicity of gauge was the single worst factor; interminable delays were encountered at major terminals as cargo was offloaded from one line and reloaded on another because the cars themselves could not travel on the different gauge.

The use of rivers was widespread, Denney (1994:17): "Boat transportation was both cheap and reliable." To prevent the South from importing weapons and other supplies, the North sought control of the waters; Wood and Edmonds (1905:27-28) commented: "The command of the sea enabled the North to destroy her opponent by slow starvation: sooner or later her internal resources must be exhausted, and the Confederacy collapse from sheer inanition. The North reaped a twofold advantage from its naval supremacy. Not only did it blockade the Atlantic and Gulf coasts, but by gaining possession of the Mississippi it severed the main artery of the Confederacy. The loss of the control of the Mississippi deprived the Confederate Government of the supplies both of men and provisions which it could otherwise have drawn from Louisiana, Texas, and Arkansas, all of them great cattle breeding districts, whose inhabitants displayed military aptitude in a marked degree." Naturally, the South did have some blockade runners who did a considerable business.

Communication obviously held importance too, and the telegraph was a great aid here; Denney (1994:17): "The wires usually followed railroad tracks from city to city, and the lack of track in the South was a real handicap." The telegraph was used for setting-up contracts (Huston, 1966:182). Information was gathered by the use of observation balloons, for example, Confederate redoubts and rifle pit locations/positions were obtained this way (Huston, 1966:195; Rutenberg and Allen, 1988:37). Responsibility for procurement and distribution for the North was in the hands of four departments which were: the Quartermaster's Department which provided clothing and, was charged with the transportation of the supplies of the other departments (as in all wars around this period, the general supply of horses was problematic too, and as such their price became inflated); the Subsistence Department which furnished rations; the Ordnance Department which operated the arsenals and armories, and furnished all ordnance and ordnance stores, including cannon and artillery carriages, small arms and

accoutrements, horse equipment, ammunition and tools and materials for the ordnance service; and the Medical Department which was responsible for its own supplies (Huston, 1966:169). The American Civil War had its own 'queen of nursing' in Dorothea Dix (Huston, 1966:250) who was trained and informed by Florence Nightingale (Macksey, 1989:16). Whilst in total circa 204 000 soldiers died in combat, twice that number 400 000 died from disease and hardship (Keegan, 1993:360-361).

Various novel and ingenious equipment developments/inventions like the Gatling gun (a cumbersome, hand-cranked machine-gun invented by Dr. Richard Jordan Gatling) were introduced and, whilst offering advantages, gave support problems and eventually lead to the policy of *standardisation* and hence *interchangeability*. As Huston (1966:189) informed: "Secondary supply and maintenance problems particularly must be taken into account in adopting new items. Variety may be the spice of life, but it is poison to ordnance officers. The use of different types of weapons in a military unit multiply the problems of production, of replacement supply, and of spare parts. If the introduction of a new weapon also poses the need for a new and different kind of ammunition, clearly supply problems are further complicated." As a result of these innovations, this was probably the first time when 'making do' with captured weapons and equipment to supplement one's own inadequate supply and/or armaments industry was not feasible: the Confederates were unable to use captured Spencer repeating carbines in any numbers because, once captured ammunition was expended, they lacked the special cartridges and had no metal for their manufacture.

Some peculiar 'battleships' were built by the North and tried out in the Civil War. In 1864 the first torpedo was invented - in reality it was just a water mine - by Captain Luppis of the Austrian Navy. Ten years later, a mobile form of torpedo nearer the type known today was developed, and the British had torpedo boats specially built for the launching of them in 1877.

3.4.3 The Zulu War Of 1879

The timing of this campaign was carefully chosen, as Knight (1991:6) explained: "Most of the rain in Natal and Zululand falls in the summer months - December, January and February. During that time the rivers are swollen and tracks can easily be churned to greasy quagmires; but the grass is tall and fresh, and there would be a minimal chance of the Zulus lighting grass fires. In 1878 the whole region was suffering from a drought, so Chelmsford [i.e. Lord Chelmsford - formerly Sir Frederic Augustus Thesiger, the British chief commander] might have had the best of both worlds; in addition, the late rains were delaying the harvests, and there was the possibility that the Zulus might be distracted in a summer campaign by the need to gather their crops. Accordingly, Frere [i.e. Sir Henry Bartle Frere - the High Commissioner] timed his showdown with Cetshwayo [i.e.

Cetshwayo kaMpande - the Zulu King] to give Chelmsford all the benefits of a summer campaign." During the period given for King Cetshwayo to comply with an ultimatum, British troops were marched into position and stores amassed in many places, one of which was Rorke's Drift-Shiyane (scene of the most famous Zulu War battle), which was a Missionary, a hospital and a principal commissariate store with a stone cattle kraal for the oxen's accommodation. The ultimatum ended on 11th January 1879 with non-compliance, and so the war started. However, the drought did not last and the British began their advance in torrential downpours. As the troops advanced, they stored supplies in small stone or earthwork forts/shelters every few miles to conceal and guard the supplies along their route, which carriers/convoys laboriously trundled back and forward to fetch replenishments as required (Knight, 1991:9).

Each battalion had to carry its own ammunition, tents (the eight-man Bell tent - named after the man who invented it, rather than its shape), entrenching tools and medical equipment, not to mention rations. In Zululand these usually consisted of 'mealies' (local corn carried in 200 lb. bags), tough army biscuit in heavy wooden boxes, and tinned 'bully beef'. Fresh meat was usually 'on the hoof' and vegetables were procured where available. One column included a field bakery. These requirements alone took up about 17 wagons, without the luxury of the officers' personal baggage, and the men's bottled beer. If there was no fuel around for fires and night lighting, that too had to be carried and/or transported. For cavalry regiments, whose British-bred horses would not eat coarse local grasses, fodder also had to be carried/fetched/transported.

There were a limited number of Army General Service wagons available, but they were not ideal, since their narrow carriage, intended for European roads, made them unstable in southern Africa. The solution was to purchase local transport, which Chelmsford's harassed and inexperienced transport staff did, often at inflated prices (Knight, 1991:24). The wagons themselves were large and heavy, sometimes tented, often with a half-tent covering the rear portion only. They required between 16 and 18 oxen apiece to pull them; and if the oxen were to remain healthy they needed to be rested and grazed for 16 hours each day, which reduced their travelling potential to about ten miles per day. In/on trackless country, roads seamed by dongas or turned into a quagmire by sudden rain, it would have been much less.

Shortage of transport remained a headache throughout the war and it caused a gross impediment to Chelmsford's strategy. Knight (1991:24) described it thus: "The camp at Isandlwana was unlaagered because the wagons were about to return to Rorke's Drift to fetch supplies; Rorke's Drift proved so defensible simply because those same supplies were available to build barricades. The Second Invasion moved at such a methodical pace so that forts could be erected to guard the staging posts as the convoys slogged back and

forth along the lines of communication. Even in battle the wagons formed the surest means of defence, the *laager*. This was based on the Boer practice of circling wagons for protection in hostile country at the end of a day's trek. In 1879, especially after Isandlwana (or Isandula), transport wagons were drawn into one or more linked square laager, which was often entrenched. The usual method was to dig a trench several paces beyond the wagon line, piling the earth up inside to form a parapet. The troops would then sleep between the parapet and the wagons at night, and man the parapet at times of alarm. The wagon-drivers themselves were usually civilian contractors, with African *Voorloopers*, who walked at the head of the train, controlling the oxen with long whips."

When the main British force crossed the Mzinyathi (Buffalo) River on 11th January 1879 to invade Zululand, a small garrison, numbering about 390 men, was left behind at Rorke's Drift-Shiyane to guard the *mountain* of supplies and the hospital. After the slaughter of the British 24th Regiment at Isandlwana (or Isandula) on the morning of 22nd January 1879 the Zulus advanced forward to Rorke's Drift-Shiyane. This disturbing news reached the Rorke's Drift-Shiyane camp during the early afternoon. The British officers decided that their only hope was to defend the post/camp. With this decision made, the 250 members of the Natal Native Contingent chose to leave the post and fled in the direction of Helpmekaar. The remaining British force was left in a desperate situation as a mere 139 men - of whom 35 were patients in the hospital - had to face the attacking 4 000 or so advancing Zulus. A 1.2 metre high peripheral barricade was made using full bags/sacks of mealie and some up-turned wagons with an internal defence line made of wooden biscuit boxes.

The Zulus made attacks during the late afternoon, evening and at night. During the night, to prevent the British defenders sleeping and to unnerve them, the Zulus shouted and barracked periodically. When dawn finally broke at about 04:00 am the Zulus left, retiring in the direction whence they came. Of the 20 000 rounds of ammunition with which the British started the defence, only about 600 remained at the end. A question often asked is why did the Zulus fail to capture the post at Rorke's Drift-Shiyane despite the overwhelming odds? An explanation is that the Zulu force had left Nodwengu, their military establishment outside of Ulundi, on the 17th January. Although they travelled with the minimum of accoutrements (probably just assagais and shields), the distance to Isandlwana was about 95 km and the Zulus had covered this on foot - and probably lived off the land for some of the time. In spite of the severe defeat inflicted on the British at Isandlwana on the 22nd January, the force which attacked Rorke's Drift-Shiyane had covered another circa 14 km from Isandlwana and had crossed the flooded Mzinyathi River. All this, plus the all night vigil/attack on the post/camp must have proved too much, with fatigue and hunger having set-in. Also, it appeared that the Zulu attacks were poorly co-ordinated.

(An engaging and noteworthy point here, is that the British 24th Regiment which was a mobile entity on the offensive, was surprised by Cetywayo's hordes and the Regiment got slaughtered/massacred by the Zulus at Isandlwana; whereas the static/fixed position at Rorke's Drift-Shiyane, in a totally defensive mode backed-up by the supplies and stores within, held out and won the day.)

The standard infantry arm during the Zulu War was the 0.45 Martini-Henry rifle - Mark 2. In the early 1870s, the British War Office tested the Gatling gun and was favourably impressed, so they ordered a number of 0.45 in. Gatlings for Army use and Heavy 0.65 in. Gatlings for the Navy. The Army in Zululand was supplied with two of these guns when reinforcements arrived from Britain in March 1879. The artillery version of the Gatling was mounted on a carriage similar to the field guns, and received its rounds from a hopper which fitted above the breech. The British Gatling was designed to take standard Small Arms ammunition, the Boxer cartridge. This was not entirely suitable, since the soft metal often tore under pressure from the extractor grip, fouling the breech and causing jamming. At the Battle of Ulundi (4th July 1879, when the Zulus were decisively defeated at their own military establishment) the bolts slipped out and were hard to find in the long grass, rendering the guns ineffective at a crucial stage of the battle (Knight, 1991:30). Nevertheless, when it was working, the Gatling gun more than made up for its faults. It was ideally suited for use on the open terrain of Zululand against the Zulu massed charge.

According to the official record, during the campaign 76 officers and 1 007 men had died in action, together with 604 black auxiliaries, though this figure is a substantial underestimate. Thirty-seven officers, 206 men and 57 auxiliaries were wounded, and 17 officers and 330 men died of disease. A further 99 officers and 1 286 men were invalided 'from the command for causes incidental to the campaign'. Perhaps 7 000 Zulus had been killed in the war, and countless hundreds more wounded. The total cost of the war was estimated at the time as £5 230 323 (Knight, 1991:9).

3.4.4 The Period Prior To The Boer War Of 1899-1902

In 1884-1885 Herbert Horatio Kitchener (later Lord Kitchener) took part in the planning of the Nile expedition to avenge the attacks on General Charles George Gordon (known as 'Chinese Gordon') who was defending Khartoum (and was eventually killed/murdered by the Dervishes (Moslem population) and other Mahdi followers two days prior to Kitchener's arrival).

Firstly, however, Kitchener needed to train and position his army. His Royal Engineering skills changed the face of Egypt by his bridging the Nile and building railways with telegraph-wire following it (Churchill, 1899:177). He planned to strike

deep into the heart of the Sudan, so he organised for 'steamers' (steam-ships) and paddle-steamers to be dragged with wire-ropes/hawsers by teams of (sometimes 2 000) men over the cataracts of the river where their passage alone would have been perilous or impossible (Churchill, 1899:149-150). Various supply camps were set-up en-route like the one at Royan Island where a field hospital was also formed (Churchill, 1899:248). He made sure that the lines of communications were absolutely solid including the use of heliographs (Churchill, 1899:283-284), so that by the time it came to battle his victory was going to be a foregone conclusion. Finally, Kitchener's troops were ready, by which time the Mahdi had died, but his followers were waiting. The Dervishes were ferocious and had destroyed many other British forces. The end results were very much in favour of Kitchener because of his modern artillery army equipped with Maxim machine guns and supported by gun-boats against a *mediaeval* Dervish army. Eventually, after winning the battles of: Handub in 1888; Toski in 1889; Atbara on 8th April 1898; and Omdurman on 2nd September 1898, in which 12 000 Dervishes died whereas Kitchener lost only 48 men, Khartoum was recaptured and the power of Mahdism was completely destroyed. In all, throughout the whole campaign circa 30 000 Dervishes were killed; some, who were originally wounded only, died because aid for them was denied. For a good detailed account of the Mahdi up-rising/incidents and associated aspects/matters see Churchill (1899).

It is a truism among military historians that, while the armies of Europe blazed a trail of technological and organisational modernisation in the nineteenth century, Britain's army lagged behind. On Queen Victoria's death (i.e. 1901), the British army did not have: a general staff; a permanent divisional and corps organisation; or enlistment by conscription. The conventional explanation for this state of affairs is the remarkable persistence in the nineteenth century of colonial wars undertaken by the British; the line of argument Strachan (1990:211) took was: "Between 1815 and 1914 the British army only once fought an organized European army - in the Crimea - but it almost never ceased combat, in wars both lesser and greater, against a bewildering variety of extra-European opponents. Between 1837 and 1846, the Queen's regiments suppressed a rebellion in Canada, suffered defeat in Afghanistan and victory in China, overran the Sind, annexed Gwalior, fought the Maoris and crushed the Punjab. In an even shorter time span, between 1878 and 1881, they fought, albeit with mixed fortunes, the Afghans (again), the Zulus, and the Boers. Whereas the Prussian army could develop its institutions against a reasonably constant geographical and strategic background, the British could not." For the duration of this period the British Army fought most of it's conflicts *'out of area'* (OoA), i.e. away from the homeland. As G.F.R. Henderson (1900) (in Luvaas, 1985:185) put it: "It is useless to anticipate in what quarter of the globe our troops may be next employed as to guess at the tactics, the armament and even the colour ... of our next enemy. Each new expedition demands special equipment, special methods of supply and special tactical devices, and sometimes special armament." In 1904 the Esher Report

was published and addressed some of those "special methods of supply". One of the outcomes of this report was the setting-up of the 'British Expeditionary Force' (BEF) in 1906.

The logistics of the Boer War (1899-1902) was used as a case study for this research and a *vignette* of it is contained in the Appendices, Section 14.1 (page 343).

3.4.5 The First World War (WW1) 1914-1918

An interesting point to note about this war is that at its commencement the British Cabinet believed it would be a short war - *lasting no more than a year*. Lord Kitchener disagreed and told the Cabinet that it would last a *minimum of three years*.

Some historians have claimed that Germany had decided to go to war in 1912, but delayed any action until it had built a sufficient number of warships and submarines (as well as establishing a U-boat harbour) in her Baltic shipyards. Germany wanted to dominate the *waves*, particularly the Baltic and North Seas, and to ensure she had unimpeded access to the Atlantic. The Great World War (as it was called) was a European (a one continent) war and it has been hailed as the first *industrialised war*, although in reality it was a *hybrid*. All the conventional methods of sustaining war to-date (including *living off the land/country* and for the British the employment of *half a million horses*) were prevalent, coupled with the modern and novel; this combination presented new problems, or challenges. Machine-guns, and their rather less lethal but related equivalent, the breech-loading, small bore magazine rifle, equipped the armies of all the combatant powers that went to war in 1914. As an illustration of the magnitude and the devastating power of this 'machine gun war', British losses (i.e. deaths) were: 60 000 on the first day of the Battle of the Somme (1st July 1916) and after 4.5 months an advancement of 16 km was achieved; 13 000 inflicted at Passchendaele (1917) within 3 hours for a gain of 92 m of territory (total British casualties for the full duration here were at least 300 000); and 8 236 at Loos, again inflicted in 3 hours. All parties tried a multiplication of new artillery throughout the war which resulted in mutual attrition by the competing artilleries, devastation of the battlefield and over taxation both of the shell-producing industries at home and of the supply services nearer the front.

The Germans first used their U-boats (i.e. submarines) in this war and, for the first time in war, transportation via trucks/lorries powered by the internal combustion engine were used. These machines brought a new supply need - fuel. In the late stages of the war army tanks with 'caterpillar tracking' were introduced, and whilst they eased the transportation problems off-road and in the very muddy conditions that prevailed, they were too slow and too cumbersome to impose a decisive alteration to tactical conditions. Furthermore, only trucks/lorries could keep the tanks rolling. Far more than railways, the

truck/lorry ushered in a new age of mobility for field armies. (For some very interesting and revealing insights of trucks/motorised aspects of, in and during WW1, see Laux (1985).)

The need for fuel increased with the use of motorised transport and armoured fighting vehicles. Petroleum eventually liberated armies from horsepower; however, fossil fuels bound armies, and navies, to supply depots. Toward the end of the war both sides were looking to the newly introduced instrument of airpower to impinge directly on the civilian morale and productive capacity of the opponent, in the hope of wearing both down; however, neither the heavy aeroplane nor the airship had yet achieved the offensive capability to alter the balance. The result of these innovations and the eventual magnitude - both manpower and ammunition consumption - was as Keegan (1993:313) stated: "Supply and logistics had damaged all the combatants in almost equal measure."

As each side had their own designs, ammunition calibres and manufacturing skills for their weapons and equipment, the ammunition and spares used by one side would rarely fit the weapons and equipment of the other; interchangeability and, more importantly, interoperability, were very, very limited. So, to a large extent, the recovery of an enemy's equipment and munitions was of little benefit, because it probably could not have been incorporated into one's own artillery. All sides had similar problems pertaining to spare parts supply/availability and maintenance support for this new mechanised mode of war.

After 1871, because Prussia introduced the concept of the mass reserve army, Continental European nations followed suit; thus World War One was fought by armies numbering in the millions which obviously put military supply under pressures never before encountered. Britain had amalgamated the largest ever volunteer army. It was probably because of these army magnitudes that according to Von der Goltz (1914:457) it was the considered view of the German planners that for the supply of ammunition and other equipment, it was still, in this innocent age, expected to be 'as nothing' compared to that of food and fodder. (Indeed, there were problems as Thompson (1991:39) informed: "In the summer of 1914, the German armies, totalling about 1,485,000 men, were mobilised and deployed on the frontiers of Belgium and France in seventeen days. The Germans had made sparse arrangements to feed the horses, ordering the cavalry commanders to live off the country. ... The Germans had taken an enormous gamble. Only the fact that the war had started after the harvest, something they could not possibly have foreseen, saved them from logistic disaster.") A similar view was held by the Russians whose gloomy forecast, according to Kennedy (1988:240), was that moving fodder for the fifty divisions of cavalry, totalling nearly a million horses, thought necessary in a country so poorly served by roads, would throw such a strain on the railway system as to inhibit the moves of the reserves, slow down any offensive and

result in the breakdown of the railway system. Initially, they were both right, although to the end of the war fodder was the major item on the logistic shopping list in terms of tonnage, ammunition resupply soon became very apparent (Lynn, 1993:21) and, more critical. All sides miscalculated (i.e. underestimated) their ammunition consumption rates, Thompson (1993:40) stated by a factor of ten. A very full account of the difficulties encountered by the Germans and an analysis of the causes has been given by Van Creveld (1977:109-141).

There was another scourge to increase the misery of this war; chemical warfare had its beginning here in April 1915, when the Germans used chlorine gas on French Colonial troops and the Canadians at Ypres. Following this, the British too, used 70 tons of a cocktail of chlorine and phosgene at the Battle of Messines. The Germans, and then the British resorted to mustard gas, fired from artillery shells. This was an insidious weapon; it remained to contaminate the waterlogged ground, attacking exhausted men while they slept. Logistically, this called for procedures and precautions to be observed in the containerising, handling, storage, transportation and deployment of these harmful and noxious chemicals.

The static trench lines and the massive bombardments on the western front tied armies permanently to the supply depots. (Perhaps, because static 'nodes'/'positions' are easier for logistics/supply to reach - particularly when compared to 'mobile'/'dynamic' nodes/positions - may have been a major factor in the widespread use and the preferred strategy for *trench warfare* employed by the generals in this war?) One of the most difficult tasks - particularly for the allies - was to transport or carry supplies across/over smashed trenches, dugouts and redoubts of the battlefield where the terrain was left very uneven and very dangerous because of scattered battle debris and other collateral damage (Thompson, 1991:43). In 1915 on the western front there was a shortage of the right kind of ammunition. Support railways, both narrow and full gauge, were constructed to aid the supply flow of munitions, food and men. Also, pipelines were laid to provide running water for the trench systems (Thompson, 1991:41). In spite of all these new methods, the British soldiers who attacked in the 'Battle of the Somme' on 1st July 1916, carried with them several days' rations in case of a break in the line of supply; they were burdened, on average, with 66 pounds (lbs), (Liddle, 1992:39).

Towards the end of this war, in 1918, the first aircraft carrier was launched - named *HMS Furious*. HMS Furious was a battle-cruiser with forward and after flight decks. The alighting aircraft had to fly alongside and sideslip onto the deck, forward of the bridge. (In 1925, HMS Furious was reconstructed and fitted with an island bridge layout on the starboard side of a continuous fight deck. This became the conventional carrier design that we are familiar with and know today.)

As in all wars learning is expedited and retained for its immediate use. Towards the end of WW1 "the way to do things" had become second nature, ingrained upon those involved and "everything pushed to the limit", as Thompson (1991:47) illustrated: "In the battles of The Hundred Days, starting in August and finishing in November 1918, including breaching the formidable Hindenburg line, the British armies advanced between 60 and 80 miles, capturing more prisoners than the French and American armies combined. Learning the lessons of the past four years, obsolete tanks pulled sledges loaded with supplies, specially designed supply tanks carried supplies in their hulls, and gun tanks moved artillery pieces; all played a vital part in maintaining the momentum of Haig's advance. Even so, had the Germans not sued for an Armistice, a pause would have been necessary - the British armies were outrunning their logistics." After the war in 1919, a brilliantly imaginative programme devised by J.F.C. Fuller (the inter-war British military theorist who postulated that future wars would be fought by mechanised armies (Fuller, 1921)), called for 7 700 fighting tanks and 3 282 administrative (i.e. logistics/transportation) tanks.

In a summing up comment, Rutenberg and Allen (1988:69) concluded: "To sum up the American logistical effort in World War I, the Lines of Communication provided the flow of supplies to the fighting units from a system of industrial mobilization in the United States. Ocean transport crossed the Atlantic. Base, intermediate, and advanced depots were established in France. Transport to the fighting units was done by wagons and trucks. This flow of supplies was often pictured as a water pipeline with regulating valves." As it presented an unprecedented situation, perhaps it was WW1 where the initial idea of *fashioning* a logistics system tailored to the particular circumstances was established; after all, no previous response system could be simply 'dusted off' and put back into place/practice. The full realisation of an 'infrastructure' for logistics: supply, support and sustainment had dawned.

George Cyrus Thorpe published his book *Pure Logistics: The Science of War Preparation* in 1917, where he called for preparation in peacetime to accelerate defence industrial production in the event of future wars.

Just prior to WW2 in 1934 air to air refuelling (AAR) of aircraft was developed (Poulsen, 1939; Anon., 1990:16) and in 1949 the 'probe-and-drogue' system took over.

3.4.6 The Second World War (WW2) 1939-1945

The war of 1939-1945 was a global war on an enormous scale. In the view of one of the principal economic historians of WW2 - Prof. Alan Milward (1977) - its origin "... lay in the deliberate choice of warfare as an instrument of policy by two of the world's most economically developed states. Far from having economic reservations about

warfare as a policy, both the German and Japanese governments were influenced in their decisions for war by the conviction that war might be an instrument of economic gain." Milward's judgement that economic impulsion drove Japan to war is incontestable. It was Japan's belief that her swelling population, overflowing an island homeland deficient in almost every resource, could be supported only by taking possession of the productive regions of neighbouring China which had brought her into direct diplomatic conflict with the US in 1937-1941. It was America's reactive trade embargoes, designed to hamstring Japan's strategic adventurism, that in 1941 drove the Tokyo government to choose war rather than circumscribed peace as its national way forward. In 1941, (the year of Pearl Harbour, when the Japanese sank/destroyed or disabled 19 ships and 120 aircraft of the US's defence force), 40% of Japan's requirements of steel had to be imported to the home islands, together with 60% of her aluminium, 80% of her oil, 85% of her iron ore and 100% of her nickel. America's threat to deny her oil and metals, against a guarantee of good behaviour, as Washington should judge it, was therefore tantamount to strangulation. The 'southern offensive' was an almost predictable outcome. Adolf Hitler, however, could not argue economic insufficiency to justify his strategic adventurism.

Whilst there had been much industrialisation and other progress since 1918, surprisingly, at the outset of WW2, the Germans still depended on horse drawn wagons to support the standard infantry division, which had 1 200 wagons but only 942 trucks/lorries (Van Creveld, 1977:144). The French and Russian armies also remained heavily dependent on horses. Only the British and, later, the US forces were fully motorised, and the German and Russian armies evolved towards this goal in the last years of the war. This full motorisation posed its own problems with fuel supply, for example: in early September 1944 the immense forces of General Dwight D. Eisenhower, Supreme Commander Allied Expeditionary Forces, after brilliantly exploiting the tactical victories of the Falaise Pocket from the 10th to 22nd August, seemed on the verge of driving through to victory in Germany. By the end of September this offensive under Generals Bradley and Patton, (an offensive which if successful might have changed the whole post-war political situation in Europe), was halted by lack of petrol and ammunition. As told by Ruppenthal (1953:583): "For the next two months supply limitations were to dominate operational plans and the allies were now to learn the real meaning of the tyranny of logistics." This happened in spite of novel solutions having been developed/installed to anticipate such occurrences, like petrol pipelines laid on the sea bed of the English Channel allowing a continuous flow of fuel from Britain to France. As in most wars, consumption was underestimated and production with resupply became problematic, and the vast scale of WW2 'guzzled' huge quantities of petrol, as Hastings (1984:233) implied: "PLUTO PipeLine Under The Ocean - a device for pumping petrol direct from England to the armies in France. ... This began to yield 700 tons of fuel a day only in January 1945." - A hint that the expectations of PLUTO were

not fully met initially. PLUTO was not one pipeline but a network of pipes; the number of which increased as fuel demand rose (see Searle, 1995). The 'jerry can' was an asset for the portable on-ward transmission of fuel, and in the very muddy areas of camps and bivouacs, they were used as 'stepping stones' (Rutenberg and Allen, 1988:123). This is just one small example of duality of purpose which is a phenomenon that often occurs in war times - 'necessity *is* the mother of invention'.

Another example illustrating how important fuel was both as a resource and as an enemy target, together with the import of prioritising when certain supplies are scarce, is the decision Rommel made to forego his air cover by diverting his fuel, as Atkinson (1993:250) wrote: "In World War II, the battle for North Africa became a struggle between supply officers. The Germans and Italians found themselves perpetually short of fuel, thanks to attacks by Allied aircraft and submarines based on Malta; Rommel, his supply lines stretched a thousand miles from Tripoli to El Alamein, had to divert fuel from the Luftwaffe to keep his tanks moving, and thereby diminished his air cover. The British smartly kept their men and machines stoked by building a railroad and water pipeline behind the army as it moved." WW2 saw the increased use of tanks as weapons which were large fuel consumers too. Given the state of the tank technology at the time, it is interesting that more British tanks were lost to mechanical breakdowns than to enemy action (Foxton, 1994:55). The demand for high levels of maintenance led to the formation of centralised maintenance depots (the same principle was applied for aircraft maintenance too).

One large scale logistics exploit - 'Operation Dynamo' - in May-June 1940 was the evacuation of the total strength (i.e. 394 000 personnel) of the retreating British Expeditionary Force (BEF). Having destroyed their equipment, weapons and ammunition - so that the Germans could not benefit from these - 224 000 personnel were safely evacuated mainly from the beaches of Dunkerque. Every possible sea-craft - private, commercial and military - capable of making the return journey across the Channel from England was used. German Stukka dive bombers sunk many vessels.

Throughout this war, the tradition of 'galloping' for intelligence gathering was continued, but by using armoured-cars now, and reconnaissance regiments, not necessarily horses. The railways were also used to a very great extent by all combatants for the mass transit of: soldiers; supplies - food, munitions, and equipment; and prisoners. In fact, the Americans constructed 1 500 miles of railway tracks, numerous round houses, 3 000 miles of telegraph and telephone lines in France alone. They also built 15 000 locomotives. Most of the prisoners-of-war (PoWs) captured/held by the Germans were transported to concentration camps/detention centres by rail. (Sadly, the Germans used unique person codes on their prisoners by tattooing permanent indentification numbers on the right arms of their prisoners. Obviously, this coding

assisted their control and tracking of their *'human inventory'*.)

Not all aspects of this war were high-technololgy; for instance, in Malaya and Burmah - jungle warfare - the logistics was very low-technology. All sides used donkeys, porters, carts and bicycles on 'corduroyed tracks' to transport supplies from *nodal* air-drop points to the front-lines. As the British soldiers often passed close to the enemy's camps, they cut out/removed the vocal cords of their donkeys/asses to prevent them from braying and thus exposing their cover and closeness. Whilst this war had all the same logistic characteristics of previous wars outlined above, it has been remembered for the innovative *tools* employed and, for what Spaight (1954) called "War on Logistics", which was probably based on the American conviction that (Huston, 1966:428): "... the quickest way to complete victory lay in a strike at the industrial heartland of Germany." Therefore, rather than repeat parallel issues/matters covered in other wars earlier, the tact taken here is the reveiw of novelties introduced and, citing examples of attacks (i.e. strategic and legitimate targets) on war productive capacity in the pursuit of disenabling one's enemies.

Some targets would have been such that a blow at both production and transportation could be struck in a single attack; an example would be a raid on railway workshops or locomotive repair sheds; or an attack on oil refineries and synthetic oils. At Fawley Oil Refinery (near Southampton) there are some underground storage tanks which were constructed during WW2 for the storage of fuels for military purposes - these were not visible by overhead aircraft and were less susceptible to collateral damage, because of the earth cushioning, should the refinery be attacked/bombed. Spaight (1954:241) advised: "Oil is the life-blood of mechanized forces. It was because the Allies grasped that truth, one of the shrewdest of the German war leaders [i.e. General Herhudt von Rohden] has said, that they won in 1945. They saw that the essential need was to condemn the Germans to immobility and that the way to achieve this aim was to paralyse the nerve centre of Germany's whole strategy, the liquid fuel sources, and thus to hamstring the Luftwaffe, the Marine and the motorized formations of the army." Spaight (1954:242) continued: "So it was that the Allies' air forces, by striking at the fuel oil element of German logistics, were able not only to bring about a substantial impairment of the mobility of the German land and sea forces, but also to leave the German air force without the means of striking back at the Allies' logistics. It was a doubly profitable strategy. It paid both dividend and bonus." Attacks on transportation were very common too - an example: on the night of 1st/2nd November 1942, a British Royal Dragoon squadron, after successfully negotiating an enemy minefield at El Alamein by the break of daylight, pursued its objective of destroying 100 enemy transport vehicles, a tank and several guns, and it also captured a very large number of prisoners.

The Germans attempted to cripple British logistics; the huge air offensive which they

began in August 1940, had the definitive aim of creating a crisis of supply in the UK; Hitler's Directive, No. 17 of 1st August 1940 (from Shulman, 1947:47) said: "After gaining temporary or local air superiority, air attack will be continued on harbours, paying special attention to food storage depots and particularly food storage depots in London." At a Staff Conference on 8th/9th January 1941, Hitler directed (from Martienssen, 1948:100) that: "... attacks on Britain must be concentrated on supplies and the armament industry ... the supplies and ships bringing them must be destroyed. Continued assaults by the Luftwaffe and the Navy on imports might lead to victory as early as July or August." This hope was not achieved because the Luftwaffe's bomb-aiming equipment was too crude, its personnel too inadequately trained in night operations to succeed in identifying and knocking out the targets that really mattered for this purpose. The German strategic offensive was, on the whole, a ham-fisted affair. Early on in the Atlantic Campaign (Van der Vat, 1988) there was some euphoria because of the successes of the German U-boats deployed to carry out their indiscriminate *sink-at-sight* policy on Atlantic merchant shipping to prevent any supplies/aid from the US getting to Britain and the Allies. However, this stimulated the search for techniques to detect submarines (i.e. short-wave radio detection and range (radar)) and when operational, considerably reduced the German U-boats' successes. When the Germans embarked on their eastern front - with the Russians - they had their own logistic and supply problems in sustaining two war-fronts.

Re-armament by the American industry had revived its economy which had been badly stricken by the Great Depression, from which America had much surplus manufacturing capacity. Between 1941 and 1945 the US's economy underwent the largest, most rapid and sustained expansion ever known; gross national production (GNP) increased by 50%, while war production, which increased from 2% to 40% of output between 1939 and 1943, was largely financed out of revenue rather than borrowing. Labour productivity improved by 25% and utilisation of plant increased from 40 to 90 hours a week; as a result shipbuilding output rose by a factor of ten, rubber output doubled, steel output nearly doubled and aircraft output increased eleven-fold, so that, of the 750 000 aircraft produced by the principal combatants during the war, 300 000 originated in the US of which 90 000 were built in 1944 alone (Milward, 1977:64-69, 76). It was America's industry that overwhelmed the German and Japanese enemies, though only because American shipyards also supplied the transportation to move it. More than 51 000 000 tons of merchant shipping was built by US shipyards between 1941 and 1945, representing some 10 000 Liberty and Victory freighters and T-2 tankers, produced by a revolutionary process of prefabrication which, for demonstration purposes, could take a vessel from start to launch in four days, fifteen hours; on average the US, at the height of the Liberty-building programme, was launching three ships a day (Van der Vat, 1988:229, 270, 351).

In the pursuit of limiting the German attacks on the Allies' supply shipping, a raid was conducted on St. Nazaire on 28th March 1942. St. Nazaire was one of the main ports on the west coast of France, and had a very large dry dock capable of holding the biggest battleships. In addition to the dry dock, the Germans were building U-boat bunkers, shielded from aerial attack by tons of concrete. Fortunately, the raid was a success and, the use of St. Nazaire was denied to the Germans, so a significant hampering to the German's naval capability was achieved. The Allies knew that to invade Europe meant that a sea-port for bringing in supplies was of paramount importance. So, on 19th August 1942 a raid on Dieppe was mounted. It was the biggest raid of the war and was designed to discover whether a large port could be captured at the beginning of any future invasion of Europe. As a raid, this mission was a disastrous failure: of the 6 000 men who took part 3 670 became casualties; 106 aircraft, a destroyer and 29 tanks were lost. But, it taught lessons which were invaluable on D-Day some two years later.

In an attempt to prevent the Allies' ingress into Europe via the French Atlantic coast, the Germans established their *Atlantic Wall* (Shulman, 1947:88ff) - an incomplete network of coastal fortifications, supplemented by beach-obstacles and minefields - constructed in 1942-1944 between the Pas-de-Calais and the Bay of Biscay as part of Hitler's plan for an impregnable 'Fortress Europe' capable of repelling any Allied landings. On D-Day it's 'invincibility' was shown to be a myth. The eventual D-Day landing (6th June 1944) which was planned and prepared for over some two years, was sustained by a well stocked magazine of materials, materiel and soldiers situated in the UK (the US military practised, trained and rehearsed for this amphibious assault on the beaches of Slapton Sands in Devon, UK during March-April 1944). Novelties used here were the two artificial harbours (called 'Mulberry' Harbours) that were pre-fabricated and constructed/erected along a strip of beach so that armoured vehicles and heavy guns could be unloaded. One of these was lost to very bad weather conditions (leaving only the Arromanches installation) and many supplies too were lost as a result of the inclement weather, as Hastings (1984:166) accounted: "In the days following Villers-Bocage, unloading on the beaches fell seriously behind schedule in the wake of the "great storm" of 19/23 June, which cost the armies 140,000 tons of scheduled stores and ammunition."

What is not appreciated about "Operation Overlord"[24] is that the direct military objective of it was neither strategic nor tactical, but logistical. The primary objective of the plan stated: *"To secure a lodgement on the continent from which further offensive operations can be developed"*. This implied the setting-up of a *forward logistics base*. Since it was relatively clear that the war would be a battle of industries, the Allies had to be able to rapidly deliver their industrial (i.e. military hardware) output to the front lines. This being an amphibious task meant that the primary need for its achievement was port facilities. The Normandy location was selected because of its physical characteristics and

[24] Operation Overlord was the code name for the D-Day landings

its location between two major port groups - Cherbourg and South Brittany. Until ports could be taken, refitted, and opened, the beach had to handle the influx of troops and supplies. Probably as a result of the scale and magnitude of the logistic undertaking, there was much confusion, as Blank (1973) recounted: "Six days after D-Day, the English ports were so badly scrambled that troops could not be sorted into landing craft to which they were assigned. The situation became so disorganized that even available ships could not be loaded. Only extraordinary measures, such as indiscriminate shipment of troops without regard to craft-loading plans, plus an absence of enemy interference, allowed us to straighten out the chaos. Many vessels arrived in France with contents completely unknown to shore personnel. One consequence was a frantic search for 81-millimeter mortar shells, needed in the hedgerow fighting, because shore troops did not know which ships carried what cargoes. They called forward a large additional quantity of these shells from England. Even when the special shipments were made, a ship-by-ship search was required to find the desperately needed munitions. Huge quantities of supplies were unloaded from ships and piled up in such disarray that they could not be identified and issued to combat forces. Ports became so cluttered that identifiable supplies in the holds of other ships could not be moved ashore."

The development of the 'bouncing bomb' by Dr. (later Sir) Barnes Neville Wallis enabled the British to destroy the Mohne and Eder dams thus flooding and annihilating a considerable proportion of Germany's electricity generating capacity and totally disenabling their principal war production facilities in that area. Probably due to the bouncing bomb attacks, the Germans were innovative from a production standpoint too; for instance, they instigated/established a subterranean bomb and engine assembly factory at Nordhausen in Germany and an aircraft and rocket assembly factory underground in a vast grotto or cavern/gulf at Peenemünde in Austria, not far from Vienna. The Nordhausen subterranean war factory (i.e. the largest in the world) had roughly 65 km of passages and tunnels driven into the mountainside. Items produced at Nordhausen were: the V1 and V2 liquid fuel rocket engine driven flying bombs which had a range of about 325 km; these were made for about £125 each (the same price as a Volkswagen car at that time) with a production rate of 700 V2s per month; and jet engines for the Messerschmitt 262 aircraft. Prisoners were used as slave labour at Nordhausen. The subterranean venue at Peenemünde offered many advantages: it was further east and thus beyond the range of the Allies' aircraft; it could not be seen (i.e. not detectable) from the air; and all the material/product 'in and out' flow was conducted at night, in the dark. The range of the Allies' aircraft was a limiting factor and novel solutions were developed to overcome this in some measure at least, for example: disposable laminated paper fuel tanks were added to the wings of the P-51 ('Mustang') aircraft like 'pods' to increase the amount of fuel carrying capacity at 'take-off' of the aircraft. These P-51 aircrafts were used particularly to escort the B-17 bomber raids on Berlin in March 1945 and, to engage in subsequent ground strafing of air bases/fields

and other transport and strategic logistic targets. Due to the US being involved in both the European and the Pacific theatres, very often there existed a 'tug-of-war' between the two arenas for logistic support and resupply. The Allies introduced a 'requisition system' which enabled the decision makers to send the supplies where they thought could be put to best use if there was a limitation on the fulfilment of all the orders, so this became a truly 'pull' demand led arrangement (Rutenberg and Allen, 1988:121).

Hitler's quest to take Stalingrad (Operation Barbarossa) and defeat Russia proved to have many logistical problems - the first being that he had two war fronts; having had the western front, he now had an eastern front too. The ever fluctuating north-south front with Russia was over 2 000 miles long (running from Finland to the Black Sea) with 4 million men (3 million Germans and the rest of pro-Axis armies) and thus very difficult to sustain. Romania, Germany's ally, was asked to help in the sustaining and logistics support roles for the Germans as well as fighting with them. The Romanians just did not have adequate logistics and as such, dependence on them turned out to be a folly. There was a heavy dependence on horses (600 000 to tow guns, ambulances and ration wagons) because German motorised transport was not available, as it was the Germans here were using - and depended on - trucks captured in France. Foxton (1994:104) gave an example of how, in an *isolated operation* (i.e. the force had been encircled and thus cut off) at Stalingrad, the quartermasters of the German 6th Army concealed their true stocks of fuel in fear of it being taken for other uses/purposes. Communications in general were bad/inadequate but the roads were a constant hinderance because of *mud* and *ice* according to the seasons. Even when an 'air-bridge' was instigated using a fleet of Junkers 52 aircrafts, problems occurred because they had not been adapted for winter operations; however, the number of aircraft available/used was totally insufficient. (Beevor (1998) was the main source of the details contained in this paragraph.)

There were certain 'logistic target points' which, if attacked/hit, could have rendered the Japanese incapable. In the Pacific War, these *target points* were railways, tunnels and bridges. If these had been put out of action the tremendous bombing and incendiary assaults on the towns and cities would have been unnecessary. Attacks on Japanese communications would have "strangled" her more easily, as a US Bombing Survey Report[25] stated: "This strangulation would have more effectively and efficiently destroyed the economic structure of the country than individually destroying Japan's cities and factories. It would have reduced Japan to a series of isolated communities, incapable of any sustained industrial production, incapable of rapid large-scale movements of troops and munitions." All this, the Survey adds, could have been achieved at a cost of only 5 200 tons of high-explosive bombs dropped in 650 visual bombing sorties by B-29 bombers, instead of the much larger, and very expensive,

[25] United States Strategic Bombing Survey, (1946) *Summary Report (Pacific War)*, Department of Defense, Washington, pp 19

operation of actually dropping more than 160 000 tons of bombs on Japan's home islands.

An example of the importance of acquiring a logistics base in the Pacific is the battle for the island of Iwo Jima which was a heavily fortified Japanese air base. Keegan (1989:563) outlined it thus: "Because a main aim of the advance to the Ryukus was to secure better air bases for the preparatory bombardment of Japan and to drive an 'air corridor' between the home islands and the Japanese airfields on Formosa and Luzon, it was also agreed that a subsidiary base should be seized on a smaller island nearby, which could be taken more quickly, to provide a staging post and emergency landing field for B-29s. Iwo Jima in the Bonin islands seemed the best choice." The Japanese were aware of the logistic importance of Iwo Jima, as they themselves had made it an air-base, and so they defended it to the last in the 3-month campaign. Keegan (1989:566) summed it up thus: "When Iwo Jima was finally secured on 16 March, 6821 Americans had been killed and 20,000 wounded, over a third of those who had landed; the 21,000 Japanese defenders died almost to a man."

Both the US and Japan rapidly developed and enlarged the aircraft carrier to hold many more aircraft and, it is fair to state that, supremacy by the US in the use of aircraft carriers was a deciding factor in reversing the fortunes of WW2 in the Pacific. The establishment of the infra-structure and essential procedures necessary to support and operationalise these *mobile off-shore floating islands* became paramount.

In this war, the Americans demonstrated how distribution activities could be integrated into a single system. Other new techniques introduced were: Bailey bridging - quickly assembled bridges; the DUKW (pronounced 'duck') amphibious truck (Rutenberg and Allen, 1988:108ff); the mass use of parachutes; compact foods, like dehydrated foods, which were easy to pack, store, transport and, virtually non-perishable; combat rations known first as C-rations and then another form called K-rations; 'collapsible bladders' used for bulk movement and storage of water; mobile refrigerator units for food storage; and the early work for palletisation (and later, after the war, containerisation) was done with the objective of increasing efficiency and reducing costs. Eventually other new/novel and innovative weapons were introduced like: rockets; aerial (flying) bombs (which the Germans assembled underground); and other destructive packages like the Atom Bomb. Post WW2, there was not much prospect of belligerents foregoing their right to strike at an enemy's logistics in any future war. The probability was that they would do so more than ever, as Kieffer (1953:101) suggested: "The decisive battle of World War III, will be fought against production and war-making potential rather than against men." (This was certainly true for the Gulf War of 1991 when Iraqi offensive weapon production factories/plants/facilities and capacities became legitimate targets for the Allies - fuel depots, ammunition dumps, bridges and lines of

communications too.)

3.4.6.1 Land-Mines And Anti-Personnel Mines

Land-mines and anti-personnel mines were/are specifically designed and intended to hamper, restrict and/or impede the enemy's/opposition's logistics. Land-mines were placed/located to deter and, if that failed, to destroy the advancing hardware (like tanks) of an enemy. Furthermore, once the mine had been triggered and exploded, invariably a *crater* was left in the ground with other collateral damage which prevented any following hardware from using the same path. If an enemy's advance had not been totally stopped by such mines, then some accrued *time benefit* (i.e. a delay of the enemy's advance) was the gain of the land-mine(s) installer. The role of anti-personnel mines were/are fourfold: one, to deter soldiers/people (or any pedestrian) from entering what an opposing force/party considers to be a 'no entry zone'; two, to maim only (i.e. not to kill) any unfortunate person who encountered/or triggered such a mine, this led to the next two purposes; three, the sight of the maimed person (coupled with his/her suffering(s)) by his/her colleagues would result in a reduction of morale within the enemy's rank and file; and four, the medical attention and care needed to sustain the injured person would consume vital logistical resources. This last point is probably the key factor, as it is a general *rule of thumb* that each war injured person requires approximately five support staff in his term of care/medication; the consumption of these support people would then *not* be available for maintaining the other (i.e. attacking/defensive) war objective effort(s) - thus a weakening of the offensive logistics capability. The corollary, of course, being, that if the medical attention/care was not given, morale would be driven even lower because soldiers would realise that should they be unfortunate and thus suffer in the same way, they would not receive the appropriate medical succour.

3.4.6.2 The Berlin Airlift (1948-1949)

This was a massive airlift of essential supplies flown in to postwar Berlin by a fleet composed of a third British and two-thirds US aircraft (both military and civil) in round-the-clock missions. It was carried out in response to the action of the Soviet military authorities in Berlin, who had attempted to isolate (i.e. lay siege around) the city from the West and thereby tried to remove the West's military presence in Berlin by severing all overland communication routes by: rail; road; and river/canal (June 1948). In the *division arrangements* of Germany post WW2, no provisions were made for guaranteeing ground access to West Berlin; no provisions were made to supply the garrisons (containing circa 6 000 troops) and the 2.5 million population. Much of the supplies from the US came across the Atlantic by ships, into many European sea-ports, although Hamburg was one of the principal sea-ports. The reason for using many European sea-ports was to avoid vast congestions and bottlenecks that would have happened if only one or a couple of ports were specified/used. The US supplies were then transported overland (as was much of the British supplies) by rail and road to 8 West German airfields where the

planes were loaded with the supplies and then flown into 3 West Berlin airfields via three air-corridors which were internationally agreed in the *division arrangements*. Sea-planes (like the Sunderland) were also used putting-down in West Berlin lakes and rivers.

To some extent, a microcosm of the network structure necessary for feeding supplies to the Berlin Airlift was in place because the Marshall Plan[26] had been set-up. Initially, some children, the elderly and the sick were evacuated from (i.e. flown-out of) West Berlin to avoid flying-in medical equipment and special medicines. An estimated 4 500 tons/day of supplies was deemed as 'the bare-essentials' to sustain the 2.5 million people. By Autumn 1948, 5 000 tons/day of supplies were being landed in the west city. At the height of the airlift (which lasted just under 11 months) a ceaseless stream of allied aircraft were landing in West Berlin every 90 seconds. Some political propaganda days were chosen to demonstrate to the Eastern bloc that the 'air-bridge' was competent and sustainable and, at its peak, delivered just under 13 000 tons (the record) on one of those days; (13 000 tons/day was the equivalent surface transported quantity into West Berlin prior to the blockade). Supplies like dried foods, boneless meat, flour, salt, fuel, coal and medicines were packed in sacks and/or boxes which were designed to be handled by one person, as most of the handling was carried-out by manual means with only a few chutes and small conveyors used. Even cars were transported in the planes. In the winter of 1948-1949, to help keep people warm, every alternate tree in West Berlin was felled to supplement the meagre coal rations. In the spring of 1949 fresh vegetables/food were being delivered into the city.

Probably because the airlift was successfully sustained for so long (which included a winter season) and the fact that the then US President - Harry S. Truman - sent two squadrons of B-29s (i.e. between 60-70 aircraft) to be stationed at Lakenheath, East Anglia in the UK, Joseph Stalin lifted the blockade in May 1949. (The B-29 bomber was the aircraft which dropped the nuclear bombs on Japan and it had the reach/range to strike the USSR and the Eastern bloc from the UK.)

3.4.7 The Korean War 1950-1953

Logistical support in this war, for both sides, demanded creation and improvisation. In the Korean War, North Korea was supplied by China and Russia; thus it did not have its own source and system of supply and maintenance, but what it did have was people, i.e. labour. As Spaight (1954:241) commented: "The Communists in North Korea had their true logistical bases in China and, farther back, in Russia, and the Allies' aircraft were not at liberty to strike at those bases. The Communists' front line was sustained by

[26] The Marshall Plan: The popular name given to the *European Recovery Programme*, a scheme for large-scale, medium-term US aid to war-ravaged Europe, announced in 1947 by US Secretary of State, George C. Marshall. 'Marshall Aid' was rejected by the USSR and the Eastern bloc, but during 1948-1950 it materially assisted Western Europe's economic revival.

a very primitive line of supply, which for that very reason was difficult to cut. The troops at the front were provided with food and munitions carried down to them by night on porters' backs; the large, triangular wooded frames upon which the supplies were hoisted, allowed enormous loads to be transported in this way by the abundant manpower that was available." Most of the North Korean supplies (which were Russian) came from Vladivostok by sea into the port at Wonsan - on the east coast of North Korea.

From Wonsan it was a long overland haul for the North Koreans to support their advance and attempts to break through the perimeters of the American supply base at Pusan - on the south east tip of South Korea. Although the Americans used air interdiction in an attempt to impede the lines of communications of the North Koreans, these were not particularly successful because of the *berceau* camouflage effect. The Americans used the tactic of falling back onto their supply base and letting the North Koreans come to them. This 'taxing' of the North Korean supply lines caused them to endure heavy losses. Later, after what Thompson (1991:118) called the United States' 'Herculean efforts' the logistic requirements were organised for the amphibious landing of the X Corps that took place at Inchon - on the west coast of South Korea, where the second American base was set-up.

Because of the terrain: the general impassable nature of the few roads or tracks, not to mention the hilliness; and the malarial mosquitoes and rats which spread and caused many other diseases; the helicopter was the most superior, tool, weapon, transport and aid for the Americans. The wide use of the helicopter now brought more problems with their necessary support via maintenance and supply of spare parts. Some spare part shortages for other aircraft during the early phase of the war exposed a precarious position for the US which Doyle (1964:103) revealed thus: "Spare wings for the fighters we were using at the time were bought against peace time consumption rates, which were very low. When planes came back shot full of holes, fighters that should have been in the air were grounded far longer than they should have been. This loss of combat strength could have been disastrous had we been faced with active air opposition, as we were when the Japs hit the Philippines."

This Korean war offered one of the best examples of priorities used within military logistics at the strategic level, as Huston (1989:98) described: "Even in times relatively free of emergencies, certain items of equipment, for budgetary or other reasons, could be expected to be in short supply. The only way that conflicting demands for limited quantities of materiel could be met was by some system of priorities. The army's procedure was to publish a chart of priorities in the supply supplement to the troop program and troop list. In late 1949 and early 1950, this chart provided for five priority groups listed in the following order: (1) the active army, (2) reserve components, (3)

reserve stocks, (4) mobilisation reserve, (5) civil functions of the Corps of Engineers and the Alaska Communication System. Within the first group, pertaining to the active army, it was necessary to prescribe further priorities according to an alphabetical listing *A* through *M*. The rule was that when sufficient quantities of standard-type items of equipment were not available to meet all requirements, none of these items would be issued to units in a priority below *I* through *E*. Remaining quantities then would be divided on the basis of overall requirements in order of priority groups. Insofar as practicable they would be divided proportionately within priority groups."

"When the Korean conflict broke out, the European Command and U.S. forces in Austria held top priority for supplies as far as troops were concerned. Far East Command at this time was in proirity group *I* through *F*, which meant that it could receive no standard items of equipment that were in short supply until all requirements in higher priority had been satisfied. Those in higher priority included special task forces and special reserve stocks as well as troops in the European Command and Austria. After the outbreak of hostilities in Korea, G-4 and G-3 moved to change these priority assignments. The immediate change, however, was not to raise Far East Command above European command, but to put them into the same priority group."

"This reflected the thinking of high officials and officers of the Department of the Army who were anxious to keep in view the concept that Western Europe was for the United States potentially the most important strategic area. Consolidation of a European defense system continued to be the main objective. Secretary of the Army Pace considered the most important lesson to come out of the Korean situation to be "the need for really effective U.S. land force participation as a deterrent to aggression in sensitive areas, of which Western Europe is the most important.""

"Here was the beginning of a repetition of the tug of war that had developed between the Pacific areas and Europe during World War II for favor in logistic support."

As the United Nations were involved in this war, the designated 'allies' were encouraged to use facilities and equipment of a standardised nature and this strategy was a great help to keeping matters simple. In the words of Thompson (1991:117): "This standardisation simplified the supply problem." Cost consciousness was employed too together with the use of indigenous resources where appropriate as illustrated by Doyle (1964:104): "One example was the manufacture of napalm fire bombs in Japan during the Korean War. They cost $248 a copy in the States - our final contract price in Japan was $42 each and they didn't have to be hauled across the Pacific."

The logistic supply and support channels worked hard on both sides right up until the cease fire in 1953. The Korean War was viewed appositely by Hermes (1966, Vol. 4:511-512) who concluded: "Lacking construction equipment, Chiang Kai-shek had used hand labor to construct the airfields for US planes in World War II and successfully completed the huge task. In Korea the Chinese again demonstrated how manpower could

be used in quantity to take the place of machines. Although this process might be uneconomical and wasteful in principle, it was effective as an expedient and as a countermeasure. In this case superior technology, far from leading to an easy victory, produced no victory at all ... It would be unfortunate if the hard-won lessons learned in the Korean War, both on battlefield and in the negotiations should be ignored or forgotten because of the absence of victory."

Post WW2, the Berlin Airlift and the Korean War, logistics reviews, analyses and subsequent changes/improvements by the military regenerated the interest within the field with such vigour that the magnitude of improvement was quantified by Doyle (1964:104) as: "... expedited supply and transportation procedures added the equivalent of nine whole fighter squadrons - about 225 aircraft - to the effective NATO combat strength without purchase of a single extra airplane. Today, as a result of improved logistics, mostly made possible by technological advances applied by alert logisticians, our air force as a whole is 75% combat ready versus 50% ten years ago."

3.4.8 The Vietnam War 1965-1972

Prior to the American involvement, from 1961 (although ground troops were not actually employed until March 1965), in Vietnam, the French were defeated at Dien Bien Phu in 1954; France, a highly developed industrial country was defeated by an under-developed/third world country - i.e. Vietnam. (This was probably the first time in history that a poor feudal nation had beaten a great colonial power which possessed a modern industry and a massive army. North Vietnam was a peasant society with virtually no industry.) French soldiers were subjected to many diseases from the Vietnamese environment. Over 80% of Vietnam is covered by forest. The triple canopy jungle provided cover for defensive positions, movement, supply lines and depots; cover which all sides used to their advantage. Bamboo, shrubs, and grass, even in the more open areas, provided numerous excellent ambush positions and impeded movement. The Ca Mau Peninsula, at the southern tip of the country, is an expanse of stagnant marshes and low-lying mangrove forests, impassable except by small boats, and it provided hide-outs for many guerillas for most of the war. Here, the Americans embarked on a war that was to be their longest in military history and of which they had no previous experience; they were faced with an unseen enemy - the Vietcong (communist) forces hid underground, attacked US positions and then disappeared. The circumstances and situation here, again, called for much use of helicopters. By 1968 over half a million US troops were involved.

The North Vietnamese's (i.e. the communists') vital supply route track was called the 'Ho Chi Minh trail'; it was a network of tracks linking the north with the south via the jungles of central Vietnam, and supposedly neutral, Laos and Cambodia. Trucks, ox drawn carts, sampans, porters and bicycles drove day and night and kept changing tracks

to avoid detection. The bulk of the military supplies for North Vietnam had their origins in China and mostly from Russia from whom Ho Chi Minh sought aid. The Russian aid was trunked via rail from Russia, through China to the Vietcong. (The Russians later learnt that not all of the supplies were being passed-on to the Vietcong by the Chinese, who kept some for themselves. It was for this reason that the Russians did not supply anti-aircraft missiles to the Vietcong, because they feared that these would be retained by the Chinese - and this was not in line with Russian policy.)

Using helicopters, the Americans, with mobility superiority and their 'search and destroy' missions, tried hard to cut-off the supply-lines to the North Vietnamese but with very little success. The camouflage effect of the *berceau* was very powerful. During debates on the US's tactics in Vietnam, the "hawks" recommended continued heavy bombing; one of the reasons mooted for this was that (McNamara, 1995:285): "Repairing bomb damage tied up 500,000 North Vietnamese who would otherwise be free to support more directly the insurgency in the South." The counter-argument was sceptical about the effectiveness of bombing because the first objective (of three) for the Vietnam War was (McNamara, 1995:286): "To reduce the flow and/or increase the cost of the continued infiltration of men and supplies from North to South." Under intense bombing this reduction had not been achieved because, as McNamara (1995:286-287) replied: "The reason bombing supply lines had not proved decisive, ... was that North Vietnam had a highly diversified and resilient transportation system consisting of rails, roads, waterways, and trails. On these the North Vietnamese moved trains, trucks, barges, sampans, human porters, and bicycles (each of which, I noted, was capable of carrying a load of up to 500 pounds). This transport system was low-tech, easy to maintain, and possessed a capacity many times larger than necessary to carry the limited tonnage needed for military operations in the South. That was the point. Intelligence studies estimated that enemy forces in the South needed only 15 tons a day of externally supplied material other than food. The logistics pipeline from North to South, even under intense air attack, possessed an output capacity of over 200 tons daily. ... to date, we had flown 173,000 bombing sorties against North Vietnam - a huge total even when compared with Allied attacks on Germany during World War II. Fully 90 percent of those had been directed against supply lines."

After the Tet (i.e. New Year) Offensive which commenced with the concerted attack on Saigon (into which the Vietcong entered on bicycle-taxis carrying chrysanthemum with guns and weapons hidden beneath them) and then followed-on throughout the south by the Vietcong, Robert Francis Kennedy in a speech (7th February 1968) said: "It is said that the Vietcong will not be able to hold the cities, and that is probably true, but they have demonstrated that despite all of our reports of progress, of government strength, and of enemy weakness, that half a million American soldiers, with 700 000 Vietnamese Allies, with total command of the air, total command of the sea, backed by the huge

resources and the most modern weapons, that we are unable to secure even a single city, from the attacks of an enemy, whose total strength is about 250 000." A sober lesson, that within some types of war - principally jungle - capital intensive facilities do not always overcome, or impair, the old methods of sustaining a battle-front and, economically, this situation/position in Vietnam was hurting the Americans more. An air interdiction campaign cannot prevent an enemy moving supplies forward. Only if an enemy is forced to *expend* his supplies, (the vital ones being food, ammunition and fuel), faster than he is receiving them, will he become *logistically bankrupt*. Probably because the Americans used tactics for (i.e. they anticipated) a long war at the front lines without real support back home in the US for such a strategy (i.e. the anti-Vietnam war demonstrations, lobbying, etc.), their strength of massive air and sea power was not utilised to its best; so they lost the war - it could not be won on the battlefield anyway. The war ended in 1972; in total, about three million people died in this war. Many American veterans involved in the war suffered a variety of unknown diseases.

3.4.9 The Falklands War 1982

A notable point about this war was the fact that it was 'out of area' (OoA) for the British. At the time, the whole of the British defence forces were 'tailored' to counter a threat from Eastern Europe with the respective logistical plans/support designed for a defensive battle/war in central Europe - probably in Germany (Saunders, 1992:22). So, the commencement of this campaign was, using the phrase coined by Macksey (1989:182): "A Study in Improvisation." The preparation time to mount the British task force to retake the Falklands was left to the very last minute. Thompson, (1991:251) advised that the four vital days, which were known about prior to the given order, could have been 'put to good use'. As a result of the rushed organisation, ships and other transport were non-tactically, or administratively loaded, *not* combat loaded. Quoting Thompson (1991:251): "Unlike a peacetime sea-transported move to a port, where the marrying up of men and equipment can be done on arrival, ships for an amphibious operation must be combat loaded. Men, their equipment and ammunition must travel in the same ship, in formed units, thus enabling them to start fighting without delay on arriving at the beach or landing zone. The unit must be able to disembark in the right tactical sequence and grouping." The marrying up was done on the Ascension Island, which meant double handling and further delayed the onward transmission. The sorting and identification of the stores was in itself a mammoth task, but to forward anything was even more horrendous because the actual ship on which most addressees were upon, was unknown; hence there were many mis-delivered items (Thompson, 1991:262-263).

In the UK from the given word, most of the prescribed store's items were prepared ready at ports and airfields for transportation in 2 to 3 days. Virtually all of the 3 800 tons of stores, 8 000 tons of ammunition and 1 250 tons of fuel, plus equipment demanded

was on board on time. Of the 80 ships used with specific logistic roles which went to the Falklands, 50 were ships taken up from trade (i.e. STUFT) at very short notice. Whilst Ascension was the main staging post, once South Georgia was recaptured it was used as an additional staging post, particularly for extremely valuable ships such as the QEII. Ships were used for the bulk of stores because at that time the main British supply planes, the Hercules (C-130), were not fitted with air-to-air refuelling (AAR) probes for use with the 'probe-and-drogue' AAR system. The single Vulcan Bomber used in the Falklands needed 17-18 in-flight refuelling rendezvous for the route of Ascension to the Falklands. The total distance from the UK to the Falklands was 8 300 nautical miles and all the supplies for the British troops came from home, a single umbilical cord.

Fortunately, given the terrain of the Falklands, to help with the unloading, 9 Eager Beaver 4-wheel-drive rough terrain fork-lift trucks (these can be dropped by parachute (Foxton, 1994:115c)) were available, which proved a significant asset. Also, the British had brought, by design, the Volvo snow caterpillar tracked transporters that had a lower ground pressure than a man's foot (Foxton, 1994:4; Thompson, 1991:253). Although these were slow (Macksey, 1989:186) the mobility of the British proved to be better than the Argentines who were handicapped on the mobility front. Macksey (1989:185) said: "To the end the Argentines managed to average two low level Hercules transport missions each night bringing in 470 tons of urgent stores and artillery and taking out 604 wounded men, with only one Hercules shot down. Indeed at no time were the Argentines seriously embarrassed by supply problems, monotonous as their diet was and hindered as they were by Falkland farmers when attempting to purchase sheep which grazed in plenty across the islands. It was in distribution to outlying defences that the Argentines found most difficulty, in a desolate land of meagre tracks, so meagre that sea and air supply were often the only efficient means of transport - both of which were largely denied the Argentines, who soon had no ships and few helicopters available." Once the British Fleet had arrived in the Falklands the Argentines' maritime assistance was curtailed.

Much replenishment at sea (RAS) for the ships was conducted, but these operations were standard and routine as the procedures for this had been established for many years and were all well rehearsed. Once the Hercules aircraft were equipped with AAR probes the unique operation of air drop into the sea of urgent items was inaugurated. The Harrier jump-jet (VTOL) aircraft - which were also fitted with AAR probes for this campaign - became the heroes of the war and their up-keep and maintenance were sustained upon the two Aircraft Carriers HMS *Hermes* and *Invincible*. Many of the British ships were badly damaged and these were repaired by the off-shore support vessel *Stena Seaspread* (which normally worked in the North Sea), a diesel-electric ship equipped with a heavy machine shop. Interestingly, the steel plates and other repair materials used for most of the ship refurbishments were taken from the old disused whaling station and repair base on South

Georgia, i.e. Stromness, where stock had been left after it had been made redundant.

Predominantly, the British were not annihilated because of three important enemy deficiencies. First, the lack of Argentine long-range attack aircraft. Second, the fact that Argentina possessed only two Hercules tanker aircraft capable of air-refuelling to extend the reach of her mere 30 short-range attack aircraft. As a result, about half the Argentine fighter bombers were compelled, at great peril and with difficulty, to operate at maximum range. Third, the preference of the Argentines for attacks on warships *rather than supply vessels*.

The one major British supply ship which was lost, the *Atlantic Conveyor*, caused much hardship because it deprived the assault force of all its tentage and vast quantities of important engineering stores. (The Goose Green assault force was short of ammunition.) The loss also included three Chinook (i.e. big) and six Wessex (i.e. small) helicopters which were of crucial importance to heavy lift and general distribution work respectively (Macksey, 1989:186). Only one Chinook was left to carry out all of the heavy duties. Macksey (1989:186) wrote: "Henceforward, the naval Sea King helicopters, of medium lift capacity, were severely overworked by a multiplicity of tasks. The single Chinook, kept flying by maintenance marvels, was used for priority movement of ammunition and troops to a front which was at the end of ever lengthening lines of communication. In three weeks this machine carried forward 600 tons and 1,530 men and brought back 650 prisoners of war to San Carlos. Many were the painful decisions thrust upon the staff when it came to fixing priorities of lift." For portability purposes, helicopter fuel was transported and stored on the islands in 'rubber bladders' (Thompson, 1991:276; Foxton, 1994:4)). The jerry can re-emerged as well, citing Foxton (1994:4): "... these cans proved vital to the resupply chain that fuelled the generators powering the large number of isolated air defence missile launchers defending the eventual landing site."

For lack of helicopter lift (and other reasons) to supply them, the Goose Green attackers had limited ammunition. Also, the parachutists and marines who 'scrambled' across the Falklands, briefly carried loads equal to their own body weight (54 kg according to Macksey (1989:186)); because of the 'tough' terrain they were exhausted by the effort, though they were hand picked men in exceptional physical condition (Thompson, 1992:89). The cold, wet, harsh and exacting weather conditions of the South Atlantic played their part too, not just for transportion; often the troops, struggling across sodden ground were called upon to subsist on combat rations, sheltering in the most rudimentary way and, using only their small portable stoves for heating. The old-fashioned complaint of crippling 'trench foot' caused up to 20 men per day to report sick. The main cause of trench-foot was the inadequacy of the soldiers' boot, which in a more protracted campaign, could indeed have had consequences leading to ultimate failure.

In addition to the main assault on the Falklands, there were many Special (i.e. covert) Operations conducted to seek intelligence, impair and disable the Argentines, and to interdict and mislead the enemy. These took place in South Georgia, the Falklands and on the Argentine mainland; the details of the logistics for these operations are not easily available, but some scant information can be gleaned (Perkins, 1986; Ramsay, 1996:193-219; White, 1997). The monetary cost of the 1982 Falklands conflict to the British was around £3.4 billion.

3.4.10 The Gulf War 1991

This was another war that was fought 'out-of area' (OoA). As an indication of the magnitude of this Gulf War, the British component alone consisted of the deployment of 46 000 personnel, 14 700 vehicles, 87 000 tonnes of ammunition and 4.18 million rations which were transported/moved by/on 2 950 aircraft and 254 ships - all this was achieved in eight weeks. The first important feature of this war was the permission from the Saudi Arabians that their country could be used as a base and preparation area for the Allies. With the permission came a generous host nation support policy as well. The Saudis supplied most of the fuel (oil), water (twice the normal consumption was required because of the heat) and other local resources consumed by the Coalition forces.

Access to the desert areas where the Allies sited logistical depots and bases was only by road or air, as there were no railway lines as links. (With the high level of road traffic/transport at least one British soldier was killed because of a road traffic accident (RTA) - he fell off a lorry and was run-over by a trailer.) The bulk of all the heavy materiel and containerised supplies left Britain by sea via commercial vessels (at excessive charges, see Extract 2.1, page 37) through the port at Al Jubayl (on the east coast of Saudi Arabia, the port was designed to handle huge surges in workload), where a principal marshalling (rear logistics) area was established throughout the campaign. Less well known about the sea transportation is the heavy stormy weather effect on some of the ships carrying materiel through the Bay of Biscay in late 1990 (i.e. during the early winter), when the ships/vessels had to reduce speed. Some ships were forced to heave completely and others had to put into port for repairs. Deck cargo, mostly vehicles and large International Standards Organisation (ISO) containers, suffered severely with a number being washed overboard as a result (Foxton, 1994:5, 172). For the British alone, 3 000 tracked and 10 000 wheeled vehicles were part of the cargoes. Other items and resupply were transported by air. The British set-up a Forward Logistic Area near King Khalid Military City (300 km from Al Jubayl and 150 km from the Kuwait border) which possessed airstrips, a pipehead, was a road centre, and had good civilian communications.

Five months between the first deployment and the start of the war allowed time for

industry to produce 'extras, or special orders', and for the forces to establish the support plan for the offensive. Commercial companies/couriers/carriers like TNT were used by MoD to deliver parts/packets/packages etc. from the UK to troops/platoons/companies and other outfits in the desert of the Middle East. Some consternation was experienced by these couriers because the military addressees had moved their positions from the time that the delivery address was given to the courier. As a result, much 'hunting' and communications were necessary to establish the new delivery point/location of these 'mobile nodes'[27]. Of special concern was the potentially high number of casualties, as there existed the anticipation and fear, of chemical, biological and possibly nuclear engagements. For the British, the medical support function was the only section that used reservists during this war. In particular, care was taken to ensure sufficient planning and organisation of facilities to combat hygiene-related diseases, Foxton (1994:136) claimed a success with this aspect as the incidence of these was some 50% below historical rates.

Many storage depots and functional areas - Forward Locations - were set-up: for ammunition storage; as Bulk Fuel Installations (BFI); and Force Maintenance Areas (FMA) (Addy, 1992). As this was a desert war, aspects such as: sand as an impediment and an abrasive; hot day-time and cold night-time weather conditions; and as air superiority was a prime objective, the sustainment and maintenance of aircraft and helicopters, needed to be planned for meticulously. For the latter item, the Americans used their 'time-phased force and deployment data' (TPFDD) (Foote, 1993:1). This was a primary planning tool to estimate the initial logistics, quantity of resources, and other factors, required for the successful achievement of objectives requiring aircraft. During this war, both the British and the Americans used engineers and other support staff and facilities contracted from major commercial enterprises. Air raids, once started and targetted on the Iraqi resupply, meant their dug-outs were starved. With regard to tanks, travelling on sand - desert conditions - meant 50% higher fuel consumption than when driving on the normal European terrain (Foxton, 1994:134). For the fuel supply to tanks 'Pipeline Over the Desert' (PLOD) was constructed. It was longer, built by fewer men, and had less capacity than PLUTO (Addy, 1992:28). In order to keep the British tanks operating in the Gulf, all of the tanks left remaining in Germany and Britain were 'cannibalised' for spare parts. For example, due to the sand, tank mufflers and associated couplings suffered much erosion and their resupply was a problem for a period. Tanks operating under desert conditions means, Foxton (1994:135): "The consumption of spare parts will almost double the European levels." Apparently, this fact was known from WW2 days in North Africa according to the 'Desert Rats'' records, but had been forgotten.

An aid that substantially helped the allied armies was the thermal imaging that was fitted on tanks - these enabled tank operators to see at night and through smoke screens.

[27] Alan Jones - Managing Director of TNT - informed the author of these difficulties with 'mobile nodes'.

Obviously much intelligence was gathered via satellite and other reconnaissance activities. Eight dead British bodies were returned to the British Army via the Red Cross and it is assumed that these must have been on/from 'Special (covert) Operations' which were carried out too (White, 1997; Ramsay, 1996:221-251; McNabb, 1994).

3.5 Emergent Themes

Fifteen themes that emerged and re-occurred from this chronological treatise were:-

1.) Source(s) of supply;
2.) Length of supply-lines;
3.) Time of the year with regard to both weather and harvests (i.e. seasons);
4.) Quantity of supplies - related to size of armies, conflict intensity levels, and scale;
5.) Role of fixed points (i.e. forts and other nodes);
6.) Military *field engineering*;
7.) Type of transportation: horses/mules/oxen/llamas/camels/elephants, wagons, ships/boats, and later, railways, trucks/lorries, aeroplanes and helicopters, etc;
8.) Means of supply: roads, rivers/canals, seas and later, rail, pipelines and air;
9.) Duration of the conflict/war: often, very mistakenly, an expectation existed that the conflicts/wars would be of a short duration; (the Vietnam War was an exception);
10.) Specific logistics structures and arrangements were inaugurated/installed for specific campaigns/wars - a designed/tailored logistics structure/organisation for a purpose;
11.) Very often more soldiers/sailors died from diseases than in combat;
12.) The international/global aspects of military logistics and sustainment;
13.) The importance of defending one's own logistics supply lines and the strategic importance of attacking/destroying those of the enemy, (see Extract 3.1).
14.) Wars promoted the inventions of 'new tools', prompted faster communications and provided the arena(s) for them to be 'tried and tested' properly in the field; and
15.) Technological tools of war needed maintenance/knowledge support and spare parts.

3.6 Summary

It can be deduced and identified (Huston, 1966; Van Creveld, 1977; Peppers, 1988; Macksey, 1989) that there are three distinct periods of military logistics history. The first centres around the 'magazine' system (principally of the 17th and 18th centuries, but earlier too in castles, etc.), in which relatively small, area based armies stockpiled provisions and ammunition in strategically placed towns and fortresses within the theatre of operations. The second period encompasses Napoleon's strategy of 'predatory' warfare, which enabled him to deploy vast forces across Europe. In essence, he provided the logistics for his long strategic marches by extensive use of Host Nation support (either purchased or seized), and by an extended supply chain for commodities which could not be acquired *en route*. At that stage, war-fighting and its logistics support had

But when there is no king to conquer, no capital to seize, no organized army to overthrow, and when there are no celebrated strongholds to capture, and no great centres of population to occupy, the objective is not so easy to select. It is then that the regular troops are forced to resort to cattle lifting and village burning and that the war assumes an aspect which may shock the humanitarian. "In planning a war against an uncivilized nation who has, perhaps, no capital," says Lord Wolseley, "your first object should be the capture of whatever they prize most, and the destruction or deprivation of which will probably bring the war most rapidly to a conclusion." This goes to the root of the whole matter. If the enemy cannot be touched in his patriotism or his honour, he can be touched through his pocket.

Fighting the Kirghiz and other nomads of the steppes the Russians have always trusted largely to carrying off the camels and flocks of the enemy as a means of bringing their antagonists to reason. In Algeria the French, adopting the methods of Abd-el-Kader and his followers, made sudden raids or "razzias" - ... - carrying off the live stock and property of their wandering oponents. In the Kaffir wars, especially in 1852, this mode of procedure has been very common, adapted with success, and it is the usual plan of action in the small punitive expeditions in East and West Africa. The United States troops used to retaliate upon the Red Indians in similar fashion.

The destruction of the crops and stores of grain of the enemy is another way of carrying on hostilities. This method of warfare is more exasperating to the adversary than carrying off live stock; for while they appreciate the principle that the victor is entitled to the spoils, wanton damage tends to embitter their feeling of enmity. The same applies to the destruction of villages so often resorted to in punitive expeditions, but it hardly does so to the same extent, since the dwellings of these races can be reconstructed easily while their food supplies, if destroyed, cannot be replaced. It is often the case that the power which undertakes a small war desires to acquire the friendship of the people which its armies are chastising, that the system of what is called "military execution" is ill adapted to the end in view. The most satisfactory way of bringing such foes to reason is by the rifle and sword, for they understand this mode of warfare and respect it. Sometimes, however, the circumstances do not admit of it, and then their villages must be demolished and their crops and granaries destroyed; still it is unfortunate when this is the case.

(Taken from: Calwell, 1990:40-41)

(In warfare, the burning or destroying of everything that may be useful to an enemy or a prospective invader is known as a *"scorched earth policy"*.)

Extract 3.1 Depriving the Enemy of Sustenance

both been confined by the limits of muscle (human and animal) and sail power. In the latter part of the 19th century, however, the advent of steam power triggered a sequence of strategic and logistics developments which rode on the crest of, and often led, the technological wave of progress. It also heralded the emergence of the third phase of logistics: continuous supply from the national base to 'out of area' global destinations.

The introduction of railways and steamships provided the early means of strategic resupply, although the inflexibility of rail and the problems of supplying fuel to the coal-driven fleets of ships, were major limitations. The scope for strategic movement was subsequently broadened by the development of oil-fired (i.e. diesel) engine ships, the load-carrying truck and air freight/transport. This surge of technological progress was similarly reflected in the increasing complexity, mobility and fire power of combat equipment. This, in turn, sharpened warfare's voracious appetite for ammunition, fuel and maintenance support, and thus increased its dependency on supply from the national base and communications. As the 'speed of attack' increased over time, it stimulated the need for faster communications, which increased proportionally. In cases where coalition forces were deployed (very common these days), the dependency was (and is) on supply from many national bases to many global destinations, and the emphasis became (and is) one of the ability of the different forces to be interchangeable and interoperable together.

3.6.1 Summary Of The Key Evolutionary Aspects Of Military Logistics

Incident/Event	Period/Time
Stone Age Logistics - Pre-wheel days - Everything carried by people or beasts like horses/mules/oxen/camels/llamas/elephants - Horsedrawn wheelless "drag-barrows", travois or stretchers - Foraging, live off the land/country and local stores (i.e. small magazines) - Soldiers/warriors were probably craftsmen as well as fighters - Constructing some tools of war from local materials at the site of use, not carrying them - Carrying/bringing only one's own valuable, difficult to produce weapons - Diseases - no cures or medical care - more deaths from disease(s) than in combat	Pre 3000 BC
The Wheel was invented - Handcarts - Horse/mule/oxen, etc. drawn carts - Mangonels, onagers, ballistae, battering rams, etc.	?
The Trojan Wooden Horse - Concealed logistical mass transport of warriors	Circa 1200 BC
Assyrian Logistics - Building stone, fortresses/fortified cities with mattamores - Prepared/static defensive logistics was easier than distant/mobile offensive logistics	Circa 900-700 BC

Incident/Event	Period/Time
Sun Tzu's writing of: *"Art of War"*	Circa 400-320 BC
- Collective defence has a higher chance of success versus individual defence	
- Sustainment via one's enemies' supplies/stores	
- Short wars are less of a drain on resources	
Philip II of Macedon	Circa 350 BC
- Soldiers carry their own kit/equipment and accoutrements	
Alexander the Great	Circa 325 BC
- Depriving the enemy navy of coastal access	
- Release from the dependence of 'beasts of burden'	
- Split the whole army into many small groups for easier cross country sustainment	
- Floating magazine principle and always travel close to the coast	
The building of the Great Wall of China	221 BC- 220 AD
Hannibal	218 BC
- Crossing of the Pyrenees and the Alps with an army and animals	
The Romans	150 BC-350 AD
- Good roads and access	
- Specific and allocated supply/logistics tasks	
- Supply lines	
- Good overall/general discipline	
- Field engineering, building skills and some standardisation	
- Amphibious landings	
- Hadrian's Wall was built	122 AD-128 AD
Charlemange or Charles the Great	Circa 775 AD
- Introduction of supply trains	
- Fortified posts (i.e. burgs) stocked with supplies built along the frontiers	
Byzantine Logistics	Circa 500-1450
- Adopting defensive strategy thereby simplifying support logistics	
- Creative amphibious landings	
- Genghis Khan's readiness and mobility strategies	
- Soldiers/horsemen take their own remounts (usually 4 or 5) with them	
The Hundred Years War (between England and France)	1337-1453
- The English used the purveyancing system	
- Merchant shipping was used for trans-Channel transportation	
- Gunpowder and cannon were developed making carriage and handling/safety difficult	
Introduction of the Military Etape System	Circa 1500
The English Civil War	1642-1649
- Scattered garrisons relying on local support and sustainment	
- Free quartering	
- The use of scout masters (and later, c. 1700 'gallopers') for intelligence gathering	
- The discovery was made that a lack of fruit and vegetables (i.e. a lack of vitamin C) in the diet was the cause of scurvy	Circa 1750

Incident/Event	Period/Time
The Seven Years' War	1756-1763

- The first *real* world war with fighting on three continents (i.e. Europe, North America (the New World) and the Far East) and in the associated surrounding seas calling for global transportation/logistics
- The British built a large number of ships
- Britain gained supremacy of the seas/oceans

The American War of Independence 1775-1783

- The establishment of Minutemen for a high level of readiness
- Poor British administration
- Lack of logistical training and positions given by privilege rather than capabilities
- Insufficient number of transatlantic ships because of privateering
- The Americans used captured British weapons and supplies
- Water (rivers/canals) was the principal transport medium - roads were bad/non-existent

Martello towers were discovered on Corsica by the British 1794

Napoleonic Wars 1796-1813

- Magazines to stock supplies and foraging
- Factories and foundries inaugurated for the manufacture of weapons/munitions
- Good field engineering and logistics thinking
- Some standardisation in artillery
- Fighting wars on two fronts - Spanish and Russian - exhausted and depleted logistics
- Contract system for the British Army in the Peninsular War
- Martello towers were built on the English coast to resist a possible French attack

British Navy introduces lime juice as a scurvy preventive agent Circa 1805

Introduction of the railways, and then, steamships Late 1820s

Baron Henri Jomini published his book: *"Summary of the Art of War"* 1830

Introduction of the telegraph Mid 1830s

Karl Von Clausewitz's book: *"Vom Krieg" ("On War")* was published 1843

Introduction of the ambulant magazine by the Russians 1846

The introduction of steam-ships as military naval vessels 1853-1865

The Crimean War 1854-1856

- Poor relationships and bureaucracy
- Poor organisation
- Interdiction of enemy's supply lines
- Florence Nightingale and proper nursing in military hospitals
- Caused a major review of British military supply

The American Civil War 1861-1864

- Use of, and control of, waterways
- Reliance on railways for logistics supplies
- Many new weapons introduced and the attendant problems of variety
- Standardisation and interchangeability recommended by the North
- The continued use of captured weapons and equipment by opponent not possible

Incident/Event	Period/Time
The torpedo was invented	1864
The Zulu War - Weather and terrain aspects - The setting-up of strategically placed supply bases - Modification of the Gatling gun for British use	1879
The Boer War - Decentralised responsiblity but supplies came from Britain for the British - Supply of horses (needed for mobility purposes) was world wide - Use of heliographs, semaphore, air balloons, cyclist messengers and early field telephones for communications and information transmission - British columns were divided into smaller units for better mobility, etc. - Guerilla (on commando) warfare by the Boers - 'hit, run-and-hide' - Concentration camps used (i.e. warehouses for retaining prisoners/people)	1899-1902
The first part of the *"Esher Report"* was published	1904
World War 1 - Industrialised war; and the realisation of the necessity for a logistics infrastructure - Ammunition rivalled food as items of resupply - Motorised transport used for the first time, therefore need for fuels and maintenance - Tracked vehicles (mainly tanks) were introduced - better transportation through mud - Mixture of old and new facilities and the attendant variety problems - spares, etc. - Captured weapons and equipment, usually, could not be used by the other side - Pipelines used to supply water over long land distances - Chemical warfare: chlorine gas; chlorine and phosgene; and mustard gas - The supply-chain (umbilical cord) concept of 'links and nodes' - Commencement of *tailored* logistics to match the situation/circumstances/threat - Launch of the first aircraft carrier - HMS Furious	1914-1918 1918
George C. Thorpe published his book: *"Pure Logistics: The Science of War Preparation"*	1917
Development of air to air refuelling (AAR)	1934
World War 2 - Evacuation of the British Expeditionary Force from Dunkerque - Pre-fabricated mode of manufacturing - primarily for shipbuilding - Artificial harbours for the speedy off-loading for an amphibious landing - Underground facilities - fuel tanks; assembly factories, etc. - The vast consumption of petrol/fuels and the piping of such supplies - The limitation in range and reach of the mechanised transport (mainly aeroplanes) - Breakdowns of mechanised facilities was widespread - need for maintenance - Centralised maintenance depots for tanks and aircraft - The attack on enemies' war production and logistics in general - Air drops used for delivering supplies - Compact foods, like dehydrated foods - Introduction of the "Requisition System', i.e. 'pull demand' - Wide use of aircraft carriers particularly in the Pacific - Many new facilities/aids introduced and tested (e.g. palletisation, etc.)	1939-1945
The Berlin Airlift and, the development of 'probe-and-drogue' AAR	1948-1949

Incident/Event	Period/Time
The Korean War - Wide use of helicopters but enemy low-tech supply systems were difficult to interdict - Real source of the North Vietnamese supply could not be interdicted - Prioritisation of global military logistics	1950-1953
Roland G. Ruppenthal published his book: *"Logistical Support of the Army"*	1953
Henry E. Eccles published his book: *"Logistics in the National Defense"*	1959
Containerisation as a handling technique developed and introduced	early 1960s
The Vietnam War - Diseases - Wide use of helicopters in this jungle warfare - Enemy low-tech supply systems were difficult to interdict	1963-1973
James A. Huston published his book: *"The Sinews of War: Army Logistics 1775-1953"*	1966
Robert W. Croakley and Richard M. Leighton published their book: *"Global Logistics and Strategy"*	1968
Martin van Creveld published his book: *"Supplying War"*	1977
The Falklands War - Single umbilical cord - circa 8 000 miles long - for the British - Range limitations of aircraft - Air to air refuelling used - Contracting of commercial ships (STUFT) - Replenishment at sea (RAS)	1982
Eston T. White and Val E. Hendrix published their book: *"Defense Acquisition And Logistics Management"*	1984
Jerome G. Peppers Jnr. published his book: *"A History of United States Military Logistics: 1935-1985"*	1988
Kenneth Macksey published his book: *"For Want of a Nail"*	1989
The Gulf War - Use of contracted commercial shipping - Use of contracted commercial maintenance support for aircraft - Well planned use of 'nodes and links' for the total sustainment of the campaign - The impact of desert sand erosion on tank parts from WW2 was forgotten - Hygiene and medical related aspects were given a high priority	1991
Carter B. Magruder published his book: *"Recurring Logistic Problems As I Have Observed Them"*	1991
Julian Thompson published his book: *"The Lifeblood of War"*	1991
Peter D. Foxton published his book: *"Powering War - Modern Land Force Logistics"*	1994

3.6.1.1 Envoi

Winston Leonard Spencer Churchill (1874-1965 (past Prime Minister; and knighted in 1953)) in his book *The River War: an Historical Account of the Reconquest of the Soudan* (1899:165) wrote: "It often happens that in prosperous public enterprises the applause of the nation and the rewards of the sovereign are bestowed on those whose offices are splendid and whose duties have been dramatic. Others whose labours were no less difficult, responsible, and vital to success are unnoticed. If this be true of men, it is also true of things. In a tale of war, the reader's mind is filled with the fighting. The battle - with its vivid scenes, its moving incidents, its plain and tremendous results - excites imagination and commands attention. The eye is fixed on the fighting brigades as they move amid smoke; on the swarming figures of the enemy; on the General, serene and determined, mounted in the middle of his Staff. The long trailing line of communications is unnoticed. The fierce glory that plays on red, triumphant bayonets dazzles the observer; nor does he care to look behind to where, along a thousand miles of rail, road, and river, the convoys are crawling to the front in uninterrupted succession. Victory is the beautiful, bright-coloured flower. Transport is the stem without which it could never have blossomed. Yet even the military student, in his zeal to master the fascinating combinations of the actual conflict, often forgets the far more intricate complications of supply."

Today, many military personnel substitute the word *Logistics* in place of the word 'Transport' used by Churchill, so that the appropriate part of the quote becomes:-
Victory is the beautiful, bright-coloured flower. Logistics is the stem without which it could never have blossomed.

Some authors/military personnel, paraphrase it further to:-
"Logistics is the stem without which the flower of victory cannot blossom."

The historical evolution of commercial/business logistics follows in the next chapter.

4. THE HISTORICAL EVOLUTION OF COMMERCIAL/BUSINESS LOGISTICS

"The white man knows how to make everything,
but he doesn't know how to distribute it."
Sitting Bull (1834-1890) - Chief of the Dakota Sioux (Lakota) Indians: he made this comment whilst touring the US east coast with William F. Cody (i.e. Buffalo Bill) in "The Wild West Show" (circa 1885).

As the chances of obtaining *live data* from the commercial/business sector appeared very slim at the outset of this study/research because of commercial confidentiality and perceived competitive advantage, the work conducted in this chapter was primordially a *back-up* measure. Here, again from the literature, an historical evolution of commercial/business logistics is traced/tracked in a general sense initially, and then via the principal academics/authors/contributors/practitioners/gurus in the field since 1900 who have recorded their contributions and thoughts, using them as the milestones. The works and comments from such people and some eyewitness accounts of the more recent aspects were pursued for the historical evolutionary path of commercial/business logistics, mostly from the commencement of the 20th century. In addition, the work for this chapter yielded data that are employed in: the *dimensions and variables* of logistics outline which is contained, later, in Chapter 7; the *categorisation of logistics types* which is discussed in Chapter 8; the *hypothesis generation* mechanism/formulation for this thesis which, is also detailed in Chapter 8; and the analytical *pattern matching* conducted in Chapter 11 (the analysis chapter).

4.1 Introduction

Early man was certainly a *hunter-gatherer*. Hunter-gatherers were populations living entirely, or almost so, by hunting animals and gathering food; they were also called *foragers* or *band societies*, as they were typically organised in bands. In all cases, the men hunted and the women foraged. In 10 000 BC the entire world population were hunters and gatherers; (today there are less than 0.001% of the world's population that continue in the hunter-gatherer mode (e.g. the Hadza people in Tanzania)). Due to the difficulties with transportation and retaining the freshness of food, these bands of hunter-gatherers would move to where the source of food, and/or other resources, existed; they were, therefore, nomadic or at least semi-nomadic because of the timeless battle with the environment. This also included migrating when the weather was unfavourable (this parallels the *birds fly south for winter* natural phenomenon); life was very much governed by the rhythm of the seasons. So, whatever was taken/carried with them had to be designed to be portable. These *portables* would then be utilised, together with resources/other materials that existed at the new location, for shelter and sustainability during the *temporary* stay there.

The concept of logistics began when hunter-gatherers and cave men *produced* food and things; more so when they were producing in excess of their needs or consumption,

as they then had to transport their surplus produce/goods elsewhere to exchange them (i.e. barter) for other items that they did not produce/make themselves (although, the term logistics, as we know it today, was included in the function and term marketing from a commercial perspective). The Bible informs us that the early Egyptians stored vast quantities of grain to sustain themselves between harvests (and longer if inclement weather or floods damaged the next crop). Heskett, Ivie and Glaskowsky (1973:5) commenced their book with: "Origins of logistics can be traced to early man. And it is perhaps appropriate that they antedate the invention of the wheel. The individuals or families stockpiling food in their caves at certain times of the year in order to survive the rigors of winter practiced a basic approach to inventory control. Later, as families produced more of certain foods or clothing than they could consume, the distribution of such goods from place to place began. Possibly as a response to the growing needs for more efficient transportation, the wheel was discovered." Even prior to the wheel, main trade routes developed (travelled by camel 'caravans') like the 'Silk Road' which linked east China to central Asia (i.e. the Middle East). Many Roman roads, built primarily for army logistics, later became prime/main trade routes. The next evolutionary concept was the centralised exchange point, i.e. most likely a village or town that became a *market village* or *market town* (maybe a *cattle market* town as well) where people came to market/exchange/sell/buy goods; this was probably the first use of what is today called a *'hub and spoke'* concept.

As the selling of goods became the life-blood of economies, the types/kinds of selling were studied and could be categorised. Shaw (1916:104-109) displayed and described the evolution of three kinds of selling: "Sale by bulk, sale by sample, and sale by description ...", and he identified that the logistical/distribution support of these three types of selling was different and he hinted that a standard support method would be complex and difficult: "... with a few exceptions, the gathering of the necessary information, the analyzing of the data secured, and the building up of a standard method of marketing which would satisfy all the conditions, is a task beyond the resources of any but the greatest of our businesses." Shaw (1916:165) also charts the evolution of distribution channels from: the producer/supplier who was always in direct contact with the consumer/customer; through where the consumer/customer had a merchant retailer/middleman in between him and the producer/supplier; to where many middlemen (wholesaler, retailer) exist in separating the consumer/customer from the producer/supplier.

Unique identification of goods and proof of ownership have been factors in the transference of goods/property again ever since trading began. Early shepherds, swineherds and goatherds used to carry a sealed clay container (shaped like a small cord-drawn money pouch) containing the same number of small stones as sheep/pigs/goats in their herds. Should a dispute occur over the number of animals in a herd, the clay pouch was smashed and the stones counted. When a herd was sold/transferred to a new owner,

the pouch would be smashed to display the true ownership number. This having been verified/established, a new clay pouch would be made for the stones which was then given to the new owner along with the herd he had just purchased/obtained/acquired. Later 'branding' (the impression of a mark from a hot iron) was used to mark each animal. From early times it was customary to brand felons/criminals and human slaves with certain marks, which, being indelible, distinguished them from their fellow men. When the overseas shipping of freight in wooden crates became widespread, the crates would be *branded* with the sender's/supplier's name/brand/trade mark to show from *where/whom* the freight had originated; hence the term 'Brand' used in today's marketing parlance.

It is very probable that the marches and movements of early warriors/soldiers in their campaigns/wars contributed to and aided the evolution of physical distribution/logistics. For instance the eight Crusades held between 1096-1272 may have been a significant foundation stone in the international commercial trading of Italy. Harmsworth (1906:1740) explained: "The crusaders, and Europe through them, were familiarized with a higher standard of comfort and luxury; and the necessity of providing transport and of keeping up supplies contributed to the rise of the commercial republics of Italy. Trade and industry both received a great stimulus, which was not exhausted when the discoveries of Vasco da Gama and Columbus gave a new direction to economic activity." An example of minimising the handling of provisions/supplies from the 15th century is circa 1438, when Venetian galleys were equipped using flow line techniques: galleys would be towed along a 'canal street' lined with warehouses and houses of arsenal. With the windows of these houses opened, as galleys sailed past, provisions, arsenal and equipment were handed out and collected by the galley crew (in: Wild, 1972:20).

In order to avoid paying excise, the 17th and 18th centuries were famous for smuggling and contraband trade; some of those principles/techniques must have advanced logistics at the time? Geographical postponement/proximity placements, storage locations/sites, speed of all the processes, handling techniques, protective packaging to prevent damaging/damages, night-time transportation, communications, and the labour intensive nature aspects - must all have prompted solutions? Likewise, many long established commercial principles of logistics were absorbed into military usage like the etape system, as Parker (1972:88) advised: "The idea was not new - 'staples' or etapes had long been in use for commercial purposes: a centre where merchants and their customers could be sure of meeting and where goods were collected for storage, sale and distribution - but in the sixteenth century the institution was adapted to military ends." The etapes (which were basically warehousing and trans-shipment centres), usually run by civilians, were a form of 'out-sourcing' practiced by the military. Indeed, third party logistics is not a new phenomenon: Wells Fargo is an example of early out-sourcing of logistics as well as a passenger service. The Pony Express, an American pioneering delivery service, was a rapid mail service from St. Joseph, Missouri to San Francisco,

California using relays of riders and horses; it was established in 1860 and pledged to deliver goods/mail/packages in ten days. The service was withdrawn after the completion of the first transcontinental telegraph line a year later in 1861.

4.1.1 Demographic And Environmental Factors

One of the factors to be considered in business logistics is demography and it is this factor alone which probably stimulated advances in logistics initially; compare the US continental mass and the UK situations of the early 1800s. As Habakkuk (1962) pointed out, because of free land in America, the 19th century population moved away from cities, so in the US there was a greater *dispersion of people* problem and geography had to be overcome. Consequently as very little labour was available in the cities, factory owners were forced to develop machinery and mechanise. This was perhaps one of the main reasons why American industry mechanised much faster in those days than did British/European/Japanese industry. Also, the industrial revolution and advancement in technology supplied solutions to the transportation barriers. The British were urbanising fairly quickly at that time and this proliferation of labour concentrated in the urban areas reduced the need for mechanisation. In Britain, many non-agricultural goods were produced by the 'putting-out system', that is goods were made at the worker's home - i.e. cottage industry. The cause or move away from the putting-out system was the organised factory centralised around a single power source - i.e. a steam engine (Gallagher, 1980). Environmental change is another factor in the stimulus for logistics development, particularly as the nature and scope of the logistics problem(s) changed dramatically with the evolution of the economy from an agricultural base (with its attendant seasonal production peaks) to an industrial (or manufacturing) base (that was usually heavily concentrated in certain regions). These environmental changes caused/created different demographic patterns and profiles. Therefore in Europe (and Japan because only about 16% of its volcanic islands were/are habitable), goods were sold primarily to populations in established centres (e.g. cities and large conurbations) with strong word-of-mouth contacts, so with these conditions, advertising was a tremendous luxury. American businesses, on the other hand, marketed their goods to a sparse and fluctuating population scattered across a vast continent, so advertising was the life-blood of established suppliers.

4.1.2 Transportation And Performance Measures/Criteria

Mass goods transit was primarily conveyed by ships and barges via seas, rivers and canals. The earliest canals, of which there are records, existed in ancient Egypt, India and China; although these were originally designed/built for irrigation purposes they soon came to be used for inland navigation as well. Canals were artificial watercourses specifically constructed for the conveyance of goods or passengers by ship, boat or barge. Canals were classified under three divisions: (1) ordinary inland navigation canals, which

connected centres of population where no navigable rivers existed; (2) lateral canals, which connected two places in the same valley, or which connected two adjoining river systems, by traversing at the most convenient point of the ridge or ridges separating their valleys, or which provided a waterway in place of a portion of a river, where, owing to waterfalls, cataracts, shallows, rapids, or tidal currents the river navigation was rendered difficult, impassable or impossible; and (3) ship canals, which provided a means of inexpensive transportation between ocean and ocean (e.g. the Panama, Suez and Corinth Canals) or between an ocean and some inland centre (e.g. the Manchester Ship Canal) - the longest of this type of canal built was the Languedoc Canal in southern France which was opened in 1681 (probably the oldest European canal) and was circa 238 km long.

The railways took over from the rivers and canals. In fact, in some cases, the canals provided all the transportation of the materials to wharves near sites for the construction of the railways and then they fell into disuse because they could not compete with the railways. A classic example of this (Dalby, 1986) was the English "Wilts and Berks Canal Company" (W&B) which took its greatest revenue and made its largest profit during 1840 - the year before the "Great Western Railway" (GWR) opened. As Dalby (1986:68) informed: "In 1840 the W&B was swamped by the traffic involved in the building of the GWR; when the fury had died down all trade declined except that in Somerset coal."

The development of the steam engine enabled steam-ships and railway engines to be built, thereby providing faster transportation over long distances and thus conquering the geographical problems. According to Hopp and Spearman (1996:23) railroads "... were America's first big business, and hence the first place where large-scale management hierarchies and modern accounting practices were needed." Due to their size, complexity and reliance on a hierarchy of managers, railroad companies required much data and new types of analysis for efficient operations. In response to this need, innovative measures and procedures were derived by Americans J. Edgar Thompson (of the Pennsylvania Railroad) and Albert Fink (of the Louisville & Nashville Railroad) who invented many of the basic techniques of modern accounting during the 1850s and 1860s. Their specific contributions included the introduction of standardised ratios (e.g. the ratio between a railroad's operating revenues and its expenditures, called the *operating ratio*), capital accounting procedures (e.g. renewal accounting), and unit cost measures (e.g. cost per ton-mile). Henry Varnum Poor (editor of the *American Railroad Journal*) widely publicised these new accounting techniques and they rapidly became standard industry practice. In addition to being the first big businesses, the railroads, along with the telegraph, paved the way for other future big businesses by creating a mass distribution network and thereby making mass markets possible because they could be reached. The rapidly expanding railways not only linked local markets to regional and national markets but further contributed to the potential of economies of scale in manufacturing as well as transportation. As the transportation and communication systems improved, commodity dealers, purchasing agricultural products from farmers and selling to processors and

wholesalers, began to appear in the period 1850-1870. By the 1870s and 1880s, particularly in America, mass retailers, such as department stores and mail order houses, followed suit.

The mass-distribution systems of the retailers (some, provided home deliveries too), and mail order houses also produced important contributions to the development of accounting practices. These enterprises had to be extremely cost conscious because of their high volumes and low margins. Analogous to the use of operating ratios by the railroads, retailers used gross margins (cost of goods sold and operating expenses subtracted from sales revenues). Similar to the railroads, retailers were single-activity firms so they developed specific measures of process efficiency unique to their type of business. Whereas the railroads concentrated on cost per ton-mile, the retailers focussed on inventory turns or "stockturn" (the ratio of annual sales to average on-hand inventory). According to Johnson and Kaplan (1987:41) a man named Marshall Field was tracking inventory turns as early as 1870 and who, according to Chandler (1977:223), maintained an average of between five and six turns during the 1870s and 1880s; (perhaps, numbers that equal or better the performance of many retailing operations today?)

Interestingly, a retired British Army Brigadier, who was a cartographer and a railway enthusiast, once told the author that in the early 1900s, due to the railway network design, layout and construction, no part of England was more than seven miles away from an operative railway station.

With the advent of the internal combustion engine, relatively fast 'door-to-door' transport of bulk by road became possible. This has led to the present day legacy where the greatest portion of our transported materials/goods/products is carried by road with the attendant problems of traffic congestions, induced vibrations, accidents and safety matters, and pollution issues. (In the 1990s, for the UK, the approximate split of freight transported by weight is: Road 82%; Rail 9%; Water 4%; and Pipeline 5%; Air is negligible.) The aeroplane, subsequently, offered speed albeit at a high per unit weight cost. Air transport has always faced the dilemma of speed versus cost comparison. The criteria for the development of the supersonic aircraft Concorde versus that of the Boeing 747 (Jumbo) aeroplane highlight this fact. The design criterion for the Concorde was to cross the Atlantic in less than four hours, and it does, in fact in 3.5 hours, but there is a very heavy cost penalty; whereas the criterion for the Boeing 747 development was a low cost per passenger-mile (or low cost per freight weight-mile). Today, most airline operators, when selecting the engines to be fitted to their new aircraft, choose the engine that gives/achieves the lowest 'specific fuel consumption' (sfc), i.e. economy of fuel.

4.2 Pioneers Of Physical Distribution Management

The early academic texts on Physical Distribution Management (PDM as it became

known) came from the US. In fact commercial/business logistics emerged from the marketing discipline and its development was brought about by people with a marketing background. The earliest in the historical development of logistics management according to Lambert and Stock (1993:18-24) was John F. Crowell who in 1901 discussed the costs and factors affecting the distribution of farm products in a US government report titled *Report of the Industrial Commission on the Distribution of Farm Products*, Vol. 6, (US Government Printing Office, Washington, DC). Lambert and Stock (1993:19, 22) also informed us that L.D.H. Weld published a text in 1916 titled *The Marketing of Farm Products* (Macmillan, New York) in which he introduced the concepts of marketing utilities (time, place, possession) and channels of distribution.

For the early part of the 20th. century the dynamism of logistics was not given much credence. La Londe and Dawson (1969:60) commented thus: "In the early twentieth century management tended to equate physical distribution with transportation and, to a more limited extent, with storage. The physical distribution task was considered a static rather than a dynamic task as much or more a part of production than marketing." Probably the foundations of logistics were set in the first four decades of the twentieth century. La Londe and Dawson (1969) traced this development from the early emphasis on transport through the increasing recognition of cost efficiency to the recognition of the role of the physical distribution department/management in competitive marketing strategies.

4.2.1 Arch Wilkinson Shaw

Arch Wilkinson Shaw was probably the first author of a business/commercial logistics text this century when in 1915 he published his book *Some Problems in Market Distribution*. The following year he published a second book (which is much more notable) about business problems and the strategic aspects of logistics; here he focussed particularly on the market place where he made a clear statement of the conceptual division of marketing into two halves, demand creation and physical supply; for example Shaw (1916:100) explained: "The problem of distribution to-day is more complex. Broadly speaking, it divides into two sub-problems closely related and interdependent but each having to do with a different set of factors and reactions. The first takes shape in the question: Given a particular article, how can a demand for it be created of sufficient volume to make its production and distribution profitable? The second is: Through what channels can the article itself be conveyed from the factory warehouse, where it is of least value, into the hands of those consumers who will pay the most profitable price for it, though this price may not be the highest at which a more limited volume could be sold?"

A.W. Shaw showed a perception of the strategic possibilities realisable in the physical supply/distribution functions; for example, here are some of his comments. Shaw (1916:101): "The relations between the activities of demand creation and of physical

supply, in fact, illustrate again the persistence of the two principles of interdependence and balance. Failure to coordinate any one of these activities with its group-fellows and also with those in the other group, or undue emphasis or outlay put upon any one of these activities, is certain to upset the equilibrium of forces which means efficient distribution." Shaw (1916:107): "... the physical distribution of the goods is a problem distinct from the creation of demand, though it is one which must be considered at every step in any solution arrived at." Shaw (1916:110-111): "Broadly, then, the problem of distribution is to bring about an effective adjustment between demand creation and economical supply, to arouse the desired maximum of demand at a minimum of expense, and to supply without leakage the largest possible percentage of this demand. The second phase of the problem involves the elements of time, convenience, and service. If the demand which has been aroused among consumers is to be fully utilized, it must be possible for them to obtain the goods promptly and without undue effort at the moment when the demand shows itself. In many cases certain collateral services must be provided, such as instruction in their use, subsequent repairs, and the like. If the consumer's interest and desire to try a certain food product have been stimulated through an advertising campaign, but the product itself is not to be had at a convenient grocery store when the buying impulse is at its strongest, the resulting leakage of demand, if it is at all general, is bound to defeat the manufacturer's purpose."

"Not a few costly failures in distribution campaigns have been due to such a lack of coordination between demand creation and physical supply, to the producer's neglect either to provide stocks of his commodity at points easy of access to the consumer or to enlist to the same end the interest and cooperation of the middlemen who are the usual sources of supply. Instead of being a subsequent problem, this question of supply must be met and answered before the work of distribution begins; otherwise the leakage may endanger the result. Middlemen do not cover all fields efficiently. The branch house or store is an expensive undertaking. An exclusive sales force means a constant outlay. Mail orders and direct shipments are effective only in distributing certain kinds of merchandise and in reaching certain sections and classes of consumers."

Shaw's (1916) reference to *economical supply* is probably the first trace, or birth, of the total cost concept of physical distribution (having separated it from demand creation); his remarks about *collateral services* are interesting too, given that to-day logistics encompasses the provision of many services as well.

4.2.2 Paul Terry Cherington

The next pioneering author was Paul Terry Cherington, who published his book *The Elements of Marketing* in 1920. He saw PDM as a part of marketing (Cherington, 1920:1-2): "The term "marketing", ... is designed to cover the complex group of services involved in the distribution of merchandise from producer to consumer, excluding only those functions which involve alterations in the form of the commodity." Cherington also

indicated four maladjustments of a mass production economy, which were: (1) quantity produced and consumed; (2) quality (i.e. grades); (3) time between production and consumption; and (4) place of production and consumption. He then offered four marketing activities designed to remedy these maladjustments; they were respectively: (1) assembling and disbursing; (2) grading and classifying; (3) storage; and (4) transportation and moving. With regard to point (2) Cherington (1920:74) was adamant that: "Compared with the cost of its performance there is none of the marketing functions which enhances the value of commodities as greatly as this one of grading." For the last point (4) he made a distinction between the commercial transfer and the physical transfer functions. Cherington (1920) commented: "The commercial function of correcting the maladjustment between the place of consumption and the place of production should not be confused with the phenomena concerned with the mechanical tasks involved in the physical transfer of goods from place to place. ... The transportation industry lies outside of, although it is wholly indispensable to, the mechanism for the commercial distribution of merchandise. What is here under consideration is in short the commercial, as distinct from the physical, movement of merchandise."

In pursuit of achieving optimum distributive efficiency, Cherington (1920) took an analytical approach which was illustrated by his population-distribution (i.e. demographic density) map of Iowa. Prompted and guided by this map of population size clusters, he suggested a producer might superimpose a network of factories/plants and warehouses upon it.

4.2.3 Paul Dulaney Converse - His First Landmark

In 1921 Paul Dulaney Converse published his book *Marketing Methods and Policies* in which he made an enlightening comparison - which verified an assumption of the day - that well organised chain stores had a more rapid stock turnover than that of the jobber (a middleman) and his retailer. He (Converse, 1921:319-320) cited data to show that the average turnover period of wholesale grocers was 70 days and that of retail grocers to be 46 days, a total of 116 days, and that: "A chain store operating its own wholesale warehouse and turning its stock 7 times a year requires only 52 days to effect a complete turnover."

4.2.4 Fred Emerson Clark

A very similar text to Cherington's (1920) was published by Fred Emerson Clark in 1922 titled *Principles of Marketing* (in which many of Clark's footnotes refer to Cherington's book and works). This text defined marketing as those efforts which affect transfers in the ownership of goods and care of their physical distribution. F.E. Clark was one of the first authors to write on the principle of concentration and dispersion in the movement of goods (Clark, 1922:2-4, 19-20, 39-42); his main focus was on the role of

transportation rates as a factor affecting market delineation and competitive success. He (Clark, 1922:305) postulated: "Other things being equal, the seller who has the lowest transportation costs on the materials, equipment and supplies which he uses and on the shipment of his product to market can sell at the lowest price, makes the greatest net profit, and, if his supply is great enough, may even control the market." Not only did Clark identify the role of logistics in marketing, he implied its power to control the market, and hinted at the fact that distribution/logistics could be employed as a competitive strategy/weapon.

4.2.5 Theodore N. Beckman

In 1926, Theodore N. Beckman published his book *Wholesaling* which was the first comprehensive treatise of the wholesale level in the marketing channel. This text gave a good example of the "traffic management conception of the physical distribution function". Beckman (1926) envisioned "three more or less distinct phases of traffic management: receiving, shipping, and local deliveries." These *phases* were reiterated in a co-authored text with N.H. Engle (1937:408-414) titled *Wholesaling Principles and Practice*. (Interestingly, this book Beckman and Engle (1937) was published by the US War Department and was probably a standard/core text for a military associated education course within a logistics programme; hence there was some transfer of commercial logistics knowledge to the military, particularly outsourcing - post the Great Depression?) The general theme visualised by Beckman was one where the traffic (i.e. transport) manager would specialise in tariffs, rates, and regulations that applied to common carriers, but would not necessarily directly manage the receiving or shipping departments. To illustrate his ideas, he provided an organisation chart which revealed the conception of the loci of physical distribution activities in the 'modern' wholesaling operation which were reproduced in Beckman and Engle (1937:327).

4.2.6 Ralph Borsodi

Ralph Borsodi was the next pioneer of distribution with his book *The Distribution Age*. Borsodi (1927) was one of the first texts to define logistics as it is presently used/understood, (Borsodi, 1927:19): "There are two uses of the word distribution which must be clearly differentiated ... first, the use of the word to describe physical distribution such as transportation and storage; second, the use of the word distribution to describe what is better termed marketing." Also, his work quantified the extent of the distribution problems by using comparative ratios, Borsodi (1927:v) advised: "In the fifty years between 1870 and 1920 the cost of distributing necessities and luxuries which we consume has nearly trebled, while the cost of producing them has been reduced by more than one-fifth. If the cost of distribution continues to rise at the same rate, before the end of the next fifty years, we shall have more people engaged in the work of distribution - selling, advertising, delivering, transporting, etc. - than we shall have in the work of

production, than we shall have occupied in farming, stock raising, lumbering, mining, and manufacturing."

"It is evident that what we are saving through the lower costs of modern methods of production, we are losing through the higher costs of modern methods of distribution. The question is, "What can we do about it?"" He continued with a further comparative ratio (Borsodi, 1927:vi): "This study makes it plain that only about one-third of the consumer's dollar spent at retail is paid for production while two-thirds is paid for distribution." A sobering thought that distribution costs were twice as much as production. This prompted his main cry which was (Borsodi, 1927:9): "We must make it possible to distinguish between *the cost of distribution* and *the cost of production*." His argument was that manufacturers who were engaged in mass production and mass selling had been the active factors in the development of extravagant marketing and unnecessary transportation (Borsodi, 1927:72). His major contribution was his recognition of the significance of logistics costs (i.e. they increased for the consumer) in expanding markets.

4.2.7 Paul Dulaney Converse - His Second Landmark

P.D. Converse published another book in 1927 entitled *Selling Policies* in which he proffered (Converse, 1927:366): "The seller who can make the quickest delivery has a decided advantage, as the buyer can buy in smaller quantities, carry smaller stocks, and thus use less capital with minimum danger of losing business due to goods being "out of stock". The buyer will often pay a somewhat higher price when quick delivery is assured. This is true in both domestic and foreign trade. The importance of quick delivery has increased during the past few years with the increase in small-order buying and the increasing rapidity of style changes. Quicker deliveries have been made possible by better railroad service and an increased use of public warehouses. The small-order (hand-to-mouth) buying is partly a result of better railroad and warehouse service, but it has, perhaps, stimulated the railroads and warehouses in, giving better service."

"The local plant has an advantage in being able to make quicker delivery. The distant seller may overcome this handicap by carrying local stocks. In a highly competitive market a flour miller carried a local stock and offered to deliver his flour within one hour to any grocer in the town. In another case, a mattress manufacturer carried local stocks and the stores merely carried samples, delivering all sales from the manufacturer's stocks. In such cases, the dealers are freed almost entirely from carrying stock and tie up practically no capital in the goods. This is not necessarily the most economical method of marketing goods, but the point we are making is that these manufacturers choose this method of securing business under highly competitive conditions."

The writings of Converse (1927) suggested that premium pricing was possible (and acceptable to customers) for the assurance of quick/rapid delivery; he also, advocated and showed the foundations of JIT, some OPT principles and geographical postponement that are commonplace to-day.

4.2.7.1 The Interim Of The Great Depression

The period 1929-1934 encompassed the Great Depression; this coupled with the expensive transportation costs of the time forced a deeper consideration of the alternatives for cost efficiency in the sphere of goods movement. For instance from his researches Melvin T. Copeland (1931:300) wrote: "This chaos in the field of distribution can be understood and interpreted only when viewed as the outward manifestation of a far-reaching revolution, driven onward by primary forces which are little understood but which are too dynamic to be thwarted." The oil industry of the day was not exempt from the distribution problems which were caused by the primary forces of the changing nature of the economy and society, as Sidney A. Swensrud (1931 and 1931a) reported.

4.2.8 Ralph Frederick Breyer

In 1934 Ralph Frederick Breyer published his book *The Marketing Institution* in which he sought to demonstrate (Breyer, 1934:v): "... how the unified, synthesized marketing institution is affected by and operates under various market attributes or conditions." Physical distribution was discussed in the context of "The Marketing Institution and the Space Element." R.F. Breyer followed a concentration-dispersion theory and employed the concept of (Breyer, 1934:139) "eye photographs" to illustrate particular movement patterns from the total infrastructure of the physical movement of goods. One of his examples was an "eye photograph" of the flow of goods from a producer of various machinery and hardware products, via warehouses and wholesalers, to industrial and individual consumers (Breyer, 1934:142). An important part of Breyer's work was his integration of the physical distribution function into a total marketing system. Of equal significance was his treatment of the physical distribution function from a time (temporal) and space (spatial) perspective.

4.2.8.1 The Interim Period 1935-1945

From about the mid-1930s onwards another aspect was recognised as being fundamental to marketing and logistics - customer satisfaction. As La Londe and Dawson (1969:60) described it: "A growing emphasis on customer satisfaction combined with a focus on cost efficiency compelled a new view of physical distribution. Gradually, a perspective emerged which recognized the broad scope of the physical transfer of goods in a trade channel; intrafirm and interfirm relationships in the movement of goods through time and space; and competitive marketing strategy potentials within the physical distribution area." WW2 between 1941-1945 demonstrated how military logistics/distribution operations and activities could be integrated into a single system.

4.2.9 Malcolm P. McNair, Stuart F. Heinritz, Paul V. Farrell And Charles Albert Taff

After the war, Malcolm P. McNair (1945) reminded the business community about

the expensive nature of distribution and quoted examples where constant effort was being maintained to reduce such costs (or at least prevent them from rising). Then in 1950 McNair (1950:18) revealed and advised that an estimate of not less than 50% of the retail price of consumer goods was required to cover distribution outlays. As logistics (today) embraces purchasing, tribute should be paid to Stuart F. Heinritz and Paul V. Farrell who in 1947 published the first edition of their book *Purchasing: Principles and Applications.* In 1950 Charles Albert Taff published his first book *Commercial Motor Transport.*

4.3 Post 1950 Pioneers And Developments In Logistics

In fact the earliest discovered mention of the term business logistics occurred in 1951 when Oskar Morgenstern - then associated with the RAND Corporation - recorded some thoughts on logistics theory (Morgenstern, 1951:8-9): "There is an immediate *similarity* between *military logistics* and the logistical problems that have to be solved daily in *business* in notably precise form in line production. There are also differences, the most significant of which is the size of the military problems which far exceeds anything encountered in business. Nevertheless, one may learn from comparison because in both fields one lacks a theory and frequently even a systematic approach ... The simplicity of business logistics derives ... from the fact that there is, as a rule, an instantly accessible source available in the market. Instead of having to provide a vast closed logistical system, it is possible to restrict oneself to a much smaller individual one and to supplement it as needed."

In 1954, P.D. Converse (his third landmark) gave his famous Conference Paper titled "The Other Half of Marketing" in which he stressed the need for academicians and practitioners to study and examine the physical distribution side (i.e. the other half) of marketing. This call for the intellectual understanding of the field spawned a new interest and many rose to the challenge like:-

- Charles Albert Taff (1955) who published his book *Traffic Management: principles and practices.*
- Howard T. Lewis, James W. Culliton and Jack D. Steele (1956) whose book *The Role of Air Freight in Physical Distribution*, (Harvard Business School, Boston) introduced the concept of total cost analysis to the area of logistics.
- John H. Frederick (1956) published his book *Traffic Department Organization.*
- Jay W. Forrester (1958 and 1961) whose two publications on *Industrial Dynamics* were probably the first attempts to 'map' the transmitted vicissitudes of information and its effect along the whole supply chain. He showed how the *primary forces*, which were very dynamic, impacted and effected the whole enterprise and associated interactors, for as these migrated upstream the result that occurred was *demand amplification* at each successive stage/station. The three main causes were identified as: no demand visibility; information distortion and; 'playing around' or frequent adjustments to inventory levels.
- John Francis Magee published his article "The Logistics of Distribution" in 1960.

• James (Jimmie) Lee Heskett (1960) completed his Ph.D. thesis *Industrial Logistics, A Movement System Concept*, which had an emphasis on industrial traffic/transport management.
• Edward Walter Smykay, Donald John Bowersox and Frank H. Mossman (1961) published their book *Physical Distribution Management*, (Macmillan, New York) which was one of the first texts on physical distribution; it discussed the systems approach to PDM and the total cost concept in detail.
• Dean S. Ammer published his *Materials Management* book in 1962, the first of its kind.
• Peter F. Drucker in 1962 published his article "The Economy's Dark Continent": the fact that the cost of distribution was 50% of the retail price of goods was repeated and reported again (Drucker, 1962:103) when he referred to the topic of distribution/PDM/logistics as a matter for businesses to explore and conquer, in particular to differentiate between "value added" and "waste added" in distribution systems (Drucker, 1962:103). He continued (Drucker, 1962:265): "Perhaps the single most important lesson ... is that distribution policy and distribution system must take into account the entire flow of the product regardless of lines of ownership and legal responsibility." ...

"As restrictive as the legal boundaries are organizational and managerial boundaries within the manufacturing business itself. These tend as a rule to keep distributive costs out of sight and distribution activities unmanaged. Even in the few companies that have such a title, the "manager of distribution" usually takes over only when the product is ready to be loaded and shipped away. The major distribution costs within the manufacturing business tend, however, to lie before this stage - and so do the major opportunities for significant savings." Here was the plea for internal integration.
• Robert E. McGarrah (1963) published his book *Production and Logistics Management.*
• Jimmie Lee Heskett, Robert M. Ivie and Nicholas A. Glaskowsky Jnr. published their book *Business Logistics* in 1964.
• Karl Maxwell Ruppenthal in 1964 edited his book *Developments in Business Logistics.*
• E. Grosvenor Plowman (1964) published his book *Elements of Business Logistics.*
• In 1965, Wendell M. Stewart published his article "Physical Distribution: Key to Improved Volume and Profits" which became famous for the illustration and description via the analogy of activity 'cogs' in the distribution system.
• Frank H. Mossman and Newton Morton published their book *Logistics of Distribution Systems* in 1965.
• Reavis Cox in 1965 published his book *Distribution in a High-Level Economy.*
• Lamar Lee Jnr. and Donald W. Dobler published a book called *Purchasing and Materials Management* in 1965.
• Louis P. Bucklin enunciated the important and powerful concept of postponement in 1965 in his article "Postponement of Speculation and the Structure of Distribution".
• In 1966 Louis P. Buckling published his book *A Theory of Distribution Channel Structure* in which he stated that the best channel was formed when no other group of institutions generated more profits or more consumer satisfaction per dollar of product cost. He commented that "real world channels" were properly called "extant" channels.

• James A. Constantin (1966) published *Principles of Logistics Management, A Functional Analysis of Physical Distribution Systems.*
• Ralph E. Sims published his book *Physical Distribution Management* in 1966.
• Wendell M. Stewart (1966) published *Total Distribution - Key to Improved Sales Volume and Profits.*
• Robert P. Neuschel in 1967 published his article "Physical Distribution - Forgotten Frontier".
• John F. Stolle in 1967 published his article "How to Manage Physical Distribution".
• Norton Elliot Marks and Robert Martin Taylor published their *Marketing Logistics* in 1967.
• John Francis Magee published two books in 1967, they were *Physical Distribution Systems* and *Industrial Logistics.*
• Martin Theodore Farris and Paul T. McElhiney edited a compendium text titled *Modern Transportation, Selected Readings* in 1967.
• Edwin H. Lewis published a book called *Marketing Channels* in 1968.
• Louis P. Bucklin (1968) delivered his Paper "The Locus of Channel Control" in which he reported that it was usual to find that *one member* of the distributive channel dominated its practices and behaviour.
• Paul T. McElhiney and Charles L. Hilton in 1968 published a book titled *Introduction to Logistics and Traffic Management.*
• Donald John Bowersox, Edward Walter Smykay and Bernard Joseph La Londe (1968) published their *Physical Distribution Management* book.
• Alan H. Gepfert in 1968 published his article "Business logistics for better profit performance", in which he advocated the systems approach coupled with computerised operations research capabilities for detecting significant profit-improvement opportunities in the logistics function.
• William M. Hutchison Jnr. and John F. Stolle (1968) published their article "How to manage customer service" in which they offered six steps to help companies achieve reductions in costs and gains in profits.
• In 1969 Dean S. Ammer published his article "Materials management as a profit center", in which he advocated that the manager of materials should take an entrepreneurial approach and suggested three ground rules for better coordination, inventory control and efficiency. In essence he stressed the need for *forced cooperation* between purchasing, inventory control/management and production control.

4.3.1 Intermediate Summary

From the mid 1950s onwards (when the science of physical distribution focused on the application of mathematics and computers to the design of physical distribution systems) it is possible to see how logistics developed as a concept in four distinct, but consolidative, approaches: (a) services and transportation; (b) logistics and promotion being sub-functions of marketing; (c) logistics and materials management; and (d)

employing a systems approach to analyse the *whole* supply chain/network.

In 1956, the following comparison was made (Frederick, 1956:1): "Industrial traffic management and transportation strategy are as important as logistics in military operations. Industry is discovering this, and it has meant the enhancement of the prestige of industrial traffic management." So transportation could be construed as the first approach to logistics; indeed Taff (1968:6) stated: "Physical distribution management and business logistics are often used interchangeably in discussions on the subject." (Whilst services had always been around and recognised too, it was not fully developed until later; so it will be dealt with then.) A second approach was to treat logistics and promotion as sub-functions of marketing, certainly this was a view purported by Constantin (1966:6-10). In the following year, Marks and Taylor (1967:ix) stated that: "Presenting promotion and logistics as dichotomous is a cogent approach to the study of marketing logistics ..."

A third approach to the concept emphasised logistics and materials management; McGarrah (1963:86) was very specific concerning this matter: "Perhaps the term "logistics management" is preferable to "materials management" because it refers to supplying people (originally military personnel) with materials and services they want and need. However, materials management more commonly describes the functions of logistics in business organizations, and that is why we use it here." Also, Ammer (1968:17) wrote: "Procurement and logistics management together are the military equivalent of materials management. Procurement is concerned with issuing of contracts to design and manufacture military equipment; logistics management is concerned with getting the material to the right place at the right time." (It was evident that a semantic problem existed too.) As an aid to materials management (and possibly for an improvement in service) the principle of postponement began to be employed, both the value-added and geographical natures. The fourth approach tried to consolidate the *whole* in a *systematic manner* by employing a systems approach. The advent of powerful computers by this stage aided the possibilities of *symbolically modelling* complex logistics scenarios, which, by analyses, enabled informed decisions to be made, thus achieving optimisation (and improved profitability) of the *whole* system.

4.3.1.1 What Should This *Field* Be Called?

During the 1960s there existed a semantic problem as to what the *field* should be called because of the integration and amalgamation of most, if not all, of the functions that was taking place; the varied terms used (and titles of the books/publications listed) above is evidence of this. Stanley H. Brewer (1960) introduced the word 'Rhocrematics' because of its meaning - the flow of information and materials. One of those to furnish a comprehensive description of the semantic problem was Bowersox (1967:214) who offered: "To me, Physical Distribution is that portion of corporate management concerned with the design and administration of systems for control of raw material and finished inventory management. In a broad sense, Physical Distribution includes the integrated

planning and administration of traffic, inventory, warehousing, location, packaging, purchasing, communications and related functions."

"Many different titles have been used to describe Physical Distribution: Business Logistics, Physical Supply, Materials Management, Market Supply, Logistics of Distribution, Total Distribution, and even Rhocrematics."

A contribution to the debate from Stanley H. Brewer and James E. Rosenzweig (1967:246) was: "Over the years, various aspects of the management of material flows have been receiving increased attention. Some companies have recently taken an integrated approach to the basic subfunctions of the total material flow process, production or distribution. More and more attention is being given to "distribution management," "materials management," "industrial logistics," "landed costs," or other segments of what might be called a total systems or Rhocrematics approach." Most authorities seemed to agree with the comment that business logistics was a *sub-system* of the organisation, and Brewer and Rosenzweig (1967) defined Rhocrematics as a *total system* describing the organisation. Another author that equated Rhocrematics and Business Logistics was Richard C. Hyatt (1968). The debate about an appropriate *name/title* to call this field/topic still continues today with terms like 'Logistics', 'Supply Management', 'Supply Chain Management', 'Supply Network(s)', 'Value Chain', 'Value Stream', becoming vogue and, more recently, 'Demand Chain Management' proposed by Martin G. Christopher (1998:239).

4.3.1.2 Transition In Costs

The stimulus for the concentration on materials management at this stage within manufacturing was probably due to the fact that a transition between labour costs and material costs was taking place (especially in the 1970s), coupled with a rise in overheads. For instance a typical breakdown of the 'cost of manufacturing' (CoM) in the 1950s was: Labour 55%, Materials 30% and Overheads 15%. As a result of mechanisation, robotics and automation (i.e. the removal of labour from manufacturing, partly because of cost of labour inflation and the resultant difficult times in managing industrial relations) the equivalent comparative CoM breakdown in the 1990s was composed of: Labour 18%, Materials 57% and Overheads 25%. The material proportion and warehousing became very expensive and costly items. The Japanese, with a lack of space and no mineral resources of their own had to purchase/import everything, hence their pernickety approach to, and their development of, techniques to minimise and eliminate waste - primarily in materials and inventory. Hence JIT systems became prevalent. (Obviously, the reduction of inventory meant the release of associated tied-up capital too, which could be employed for other opportunities that increased quality, flexibility, service and responsiveness.)

The composition of shops on the High Streets began to change from individual generic retailers (i.e. butchers, green-grocers, bakers, tobacconists, clothe shops, etc.) to 'one stop shopping' supermarkets. The supermarkets became chain-stores/multiples; so,

the cost of inventory, both its value and its holding costs, became the subject of review for these major High Street multiple retailers too. These retailers were concerned about the quantity of stock - in particular *static* stock - held at their stores which was consuming potential selling space; that is the quantity of space at expensive high street locations being used as *small warehouses/stocking centres*. So a trend started whereby inventories/stocks were kept/held at cheaper *out-of-town* distribution depots and/or using better managed/organised distribution systems from trans-shipment centres (what are to-day called composite distribution centres). (Wal-Mart in the US and, Marks & Spencer in the UK were probably the first to employ such composite distribution centres.) The associated back-office and storage space at the stores themselves were then released to increase the stores' selling and display space. The result was an increase in both revenue and profit per square metre of the high street stores' space, because of the smaller individual quantities (of an item) held of a wider choice offering. (See Extract 4.1 where Marks & Spencer could turn 600 000 square feet of newly purchased selling space into 700 000 square feet because of their *'superior distribution system'*. Also note that Marks & Spencer has an average sales of nearly £600 per square foot, three times more when compared to Littlewoods with sales of only £197 per square foot.) The relationship between product availability and sales was called/named *distribution elasticity* by West (1989:13). This new technique of managing logistics (wider choice, improved availability and accessibility (for impulse purchases etc.), and later - fashion and modernity due to shorter product life cycles, etc.) now called for the continuous reduction in 'replenishment cycles'.

4.3.1.3 Transition In Power Base (And Hence Control)

Fundamentally, the distribution channel decision requires resolution of the often conflicting forces of cost and control. The concept of control must be broadened to recognise the fact that a company's ability to exercise control is a function of its competitive strength and/or purchasing power *vis-a-vis* other channel members. Thus it is usual to find that one member of the distribution channel dominates its practices (and behaviour) and is regarded as the 'locus of channel control' (Bucklin, 1968). In general the dominant members are either producers or users/consumers, but there are situations where a channel intermediary may be dominant and so conditions the structure and operation of the channel.

One of the results of the major High Street multiple retailers reviewing their inventory policies was that during the 1970s a transition in power base took place from the manufacturers/suppliers to the retailers. Rushton and Oxley (1989:7) wrote: "This decade also saw a change in the structure and control of the distribution chain. There was a decline in the power of the manufacturers and suppliers, and a marked increase in that of the major retailers. The larger retail chains developed their own distribution structures, based initially on the concept of regional or local distribution depots to supply their stores." The major retailers began to realise their power, and hence their ability to control

THE DAILY TELEGRAPH

The Questor Column

Full Marks for quality

ONLY two months ago investors thought Marks & Spencer was dull and unexciting. Although it had announced pre-tax profits of more than £1 billion (substantially higher than its nearest rival Tesco), the shares fell below 500p on fears about higher costs and weaker-than-expected food sales.

But the strong sales figures from Dixons last week, showing shoppers are out spending, helped Marks & Spencer shares surge ahead.

Yesterday there was more good news for Marks when it agreed to buy 19 of the best and largest Littlewoods stores for £192½m. Current trading, as chairman Sir Richard Greenbury disclosed at yesterday's annual meeting, is also going well.

Marks is paying more than book value, thought to be around £80m, but the deal gives it 600,000 sq.ft of selling space in the very high streets where it has been desperately seeking more space.

Deputy chairman Keith Oates thinks the company could end up with an extra 100,000 sq.ft of selling space from the stores because Marks' superior distribution system means it needs less back-office and storage space.

Marks is only buying the sites, leaving stock and redundancy costs with Littlewoods. The deal should be completed in February and the first refurbished stores should be trading by late next summer.

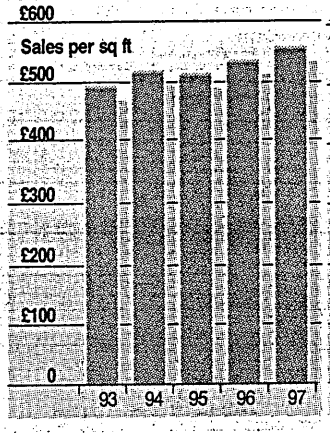
Littlewoods's sales are only £197 per sq.ft, but Marks is expected to drive up sales past its average of nearly £600 per sq.ft, as shown on the chart. They should be profitable within three years.

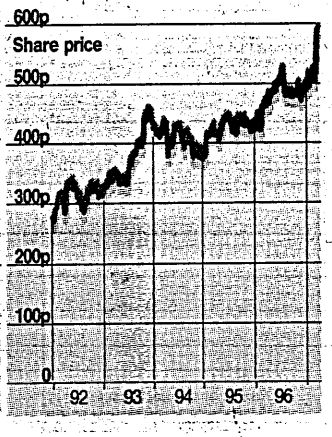
Stockbrokers are forecasting pre-tax profits of almost £1·2 billion for the current year. The shares, up 5½ to 592½p, are trading on 20 times future earnings. As one of the best-managed companies in the sector, the shares are still a long-term buy.

Marks & Spencer

Market value: £16.8bn Share price: 592½p +5½p

Year to March	1994	1995	1996	1997	1998 est
Turnover	£6.54bn	£6.81bn	£7.23bn	£7.84bn	£8.0bn
Pre-tax profit	£852m	£924m	£966m	£1.10bn	£1.17bn
Earnings per share	20.9p	22.4p	23.3p	26.7p	29.0p
Dividend per share	9.2p	10.3p	11.4p	13.0p	14.5p





(Source: *The Daily Telegraph*, Friday, 18th July 1997, page 35)

Extract 4.1 Full Marks for Quality

and dictate how they wished/wanted/preferred the whole supply chain/network to work and behave; sometimes this included rationalising the supplier base (i.e. fewer suppliers).

4.3.2 The Pioneers In The UK

Rushton and Oxley (1989:7) informed us that it was during the 1960s and 1970s that the UK imported the concept of PDM from the US. In order to aid the British learning process and understanding of the field of logistics, the following were published/printed:-

- S. Hill published a book called *The Distributive System* in 1966.
- V.G. Powell in 1967 published *Techniques for Improving Distribution Management.*
- *Purchasing Principles and Techniques* was published in 1968 by Peter Baily and David Farmer.
- John E. Sussams published his book *Industrial Logistics* in 1969.
- Felix R.L. Wentworth edited a text called *Physical Distribution Management* in 1970.
- Martin G. Christopher (1971) published his text *Total Distribution: A Framework for Analysis, Costing and Control.*
- Peter R. Attwood in 1971 published his book *Planning a Distribution System.*
- Samuel Eilon, Carl D.T. Watson-Gandy and Nicos Christofides published their book in 1971 entitled *Distribution Management: Mathematical Modelling and Practical Analysis.*
- Martin G. Christopher and Gordon S.C. Wills edited a text titled *Marketing Logistics and Distribution Planning* in 1972.
- Gordon S.C. Wills, Leonard Magrill and Allen Cooper published their article "The Analysis of European Distribution Systems" in 1972; their analysis was achieved by employing the total systems approach.
- Tom Cannon published his book *Distribution Research* in 1973.
- Nicos Christofides and Carl D.T. Watson-Gandy (1973) published their article "Improving Profits With Distribution Services": the use/definition of the word *service* here implied the provision of *something* which is of advantage to the customer.
- In 1974 a Swede, Dag Ericsson, published his book *Materials Administration* in which he promoted a logistics-like concept.

4.4 Post 1970 Pioneers And Developments In Logistics

In 1973 Frederick W. Smith created/started his US package transport/distribution company "Federal Express" (FedEx) with the slogan: "Absolutely, positively overnite!" His concept was (Altman, 1981:50): "To cut cost and time, packages from all over the country would be flown to a central point, there to be distributed and flown out again to their destinations - a hub-and-spokes pattern, his company calls it today. The flying would be done at night when air lanes were comparatively empty. Airports used would be in sizable cities, and trucks would carry packages to their final destinations, whether in those cities or in smaller communities. Equipment and documents from anywhere in the U.S. could be delivered anywhere in the U.S. the next day." Although F.W. Smith

claimed to have developed this idea in the 1960s (Altman, 1981:50), the idea was not new. 'Hub and spoke' systems have been in use - if not called that - centuries before; after all, that was the principle behind *market villages* and *market towns*. In addition, Post Offices (and company internal mail systems) worked on the same principle. F.W. Smith's great idea, and contribution, was to apply the same principle to air transport/traffic and to utilise the non-peak air-traffic times/periods, i.e. night-time.

Literature in the field of logistics continued to flourish on both sides of the Atlantic in the 1970s. Excluding revised editions of above quoted authors, some of the more notable were:-

• William G. Moller Jnr. and David L. Wilemon edited a book called *Marketing Channels: A Systems Viewpoint* in 1971.

• Louis P. Bucklin in 1972 published his book *Competition and Evolution in the Distributive Trades.*

• Gordon F. Bloom propounded the systems approach for logistics in his article "The Systems Approach To Improved Productivity In Distribution" during 1973.

• James Lee Heskett (1973) published his article "Sweeping Changes in Distribution".

• Frederick J. Beier published his article "Information Systems And The Life Cycle Of Logistics Departments" in 1973.

• Ronald Herman Ballou in 1973 published *Business Logistics Management.*

• Grant Miller Davis and Stephen W. Brown in 1974 published their book *Logistics Management.*

• C. Glenn Walters (1973) published a book titled *Marketing Channels.*

• Graham Buxton in 1975 published *Effective Marketing Logistics the Analysis, Planning and Control of Distribution Operations.*

• Douglas M. Lambert (1976) published his text *The Development of an Inventory Costing Methodology: A Study of the Costs Associated with Holding Inventory.* This publication identified the cost components of one of the largest logistics expense items (i.e. inventory) and developed a methodology whereby companies could calculate their inventory carrying costs.

• A.M. Geoffrion in 1976 published his article "Better distribution planning with computer models".

• Bernard Joseph La Londe and Paul H. Zinszer published their 'landmark' book *Customer Service: Meaning and Measurement* in 1976. This was the first comprehensive study of state-of-the-art appraisal of customer service particularly in US corporations.

• In 1977 J. Taylor Sims, J. Robert Foster and Arch G. Woodside published their book *Marketing Channels: Systems and strategies.*

• Martin G. Christopher, David W. Walters and John L. Gattorna in 1977 published *Distribution Planning and Control.*

• James Lee Heskett (1977) published his article "Logistics - essential to strategy".

• James C. Johnson and Donald F. Wood published their book *Contemporary Physical Distribution* in 1997.

• A.T. Kearney Inc. (1978) published their state-of-the-art appraisal of productivity measurement in logistics.
• Felix R.L. Wentworth and Martin G. Christopher edited a text titled *Managing International Distribution* in 1979 which brought in the international dimension.

4.4.1 The Inclusion Of Service Within Logistics

Since the concept of providing *services* or *service* itself as a value adding part of logistics, much interest in that side of commerce has blossomed. While customer service has no single definition, La Londe and Zinszer (1976:iv) defined customer service as "... a customer-oriented philosophy which integrates and manages all of the elements of the customer interface within a predetermined optimium cost service mix." One of the findings by La Londe and Zinszer (1976:119) was that the greatest portion of total order cycle time generally occurred either before the manufacturer received the order, or after the manufacturer shipped the order to the customer. In other words, activities at least somewhat "external" to the manufacturer, and thus over which the manufacturer was likely to have less control, consumed more than half of the total order cycle time. Also, according to La Londe and Zinszer (1976:156-159) customer service is thought of in three principal ways; i.e. customer service as: an activity; performance measures; and a philosophy. Having advocated the development of a customer service programme, to be effective it required the establishment of standards that (La Londe and Zinszer, 1976:180):-

(i) Reflect the customer's point of view;
(ii) Provide an operational and objective measure of service performance; and
(iii) Provide management with cues for corrective action.

For the aid of understanding and management of the same La Londe and Zinszer (1976:272-282) categorised the elements of customer service into three groups: pre-transactional; transactional; and post-transactional. It is now considered and increasingly recognised that customer service is a potential means of differentiation (Christopher, 1992:25).

4.4.2 Control Of Internal Or Manufacturing Logistics

During the 1970s and 1980s were the development and implementation of techniques in internal logistics like MRP, MPR II, DRP, DRP II, JIT (e.g. Kanban) and OPT. (The principles and philosophies of some of these will be explained later in the next chapter, i.e. Chapter 5.) As Hughes et al (1998:96) showed, the innovation in the production supply chain was built on previous platforms of best practice: progressing from MRP through MRP II and JIT to lean production and lean supply towards a responsive supply chain/network. The widespread implementation of these control systems/techniques highlighted the need for the integration of all the logistics activies/functions and optimising their effectiveness as a whole particularly with all (but especially with raw material and

component) inventory/stock reduction. In order to reduce the 'makespan'/lead-time of final products, and to reduce inventory item numbers, higher level of assemblies/modularisations were designed and outsourced/bought-in/purchased/supplied. These techniques also indicated the relationships between logistics and manufacturing, marketing, and other business functions; this was further endorsed when Michael E. Porter (1985) introduced the 'value chain' concept which itself helped to cause a major awareness that logistics could help companies create, and maintain, a competitive advantage. Such techniques were the 'platforms' for the synthesising of an organisation as a whole (i.e. a complete entity). The subsequent enabling power afforded by the computing and IT/IS advancements made the logistics *horizontal process management* aspects within organisations a reality. It fostered/encouraged information sharing *along the whole* supply chain/network because of the accrued benefits obtained (like better customer service/satisfaction) and the ease/simplicity with which information could be handled and communicated.

4.4.2.1 Integrated Logistics

Logistics may/can integrate the functions of Purchasing, Supply, Production and Distribution in order to synchronise rhythms and material flows; such a system is known as "Integrated Logistics" and is often found within the leading consumer goods manufacturers. It was during the late 1970s and early 1980s that this concept of integrated logistics evolved. In an *integrated logistics system*, inventory (or the product/service) passes/moves through a constant and consecutive chain of value added steps, with it arriving at the customer/consumer when needed in the proper quantity and form. Value added means that each party involved acts to enhance the value of the product and/or service for those who will be receiving it. Cooper, O'Laughlin and Kresge (1993:40-41) described the evolutionary integrating aspects as follows: "In the 1970s, companies began to embrace and implement the concept of 'integrated distribution'. As the benefits of integrated warehousing, transportation, and inventory management became more evident, this approach was eventually extended into marketing and manufacturing operations. In the 1980s, leading companies went even further in pursuit of 'channel integration'. This approach aimed at co-ordinating the management of materials and finished goods, from the sourcing of raw materials through to the point of final consumption of finished products. A key benefit of channel integration was that it extended the benefit of internal integration outside the firm."

"In the early 1990s, some companies in Europe are now beginning to integrate operations across national boundaries. The removal of trade barriers means increasingly that it is posible to achieve 'geographical integration', with operations spanning country borders. In the context of Europe 1992 and the emerging European Economic Area, this development is of critical importance, not only to meet the changing buying values of increasingly pan-European customers or to adopt new product strategies that transcend borders, but more importantly to reap the significant benefits available from economies of scale."

Johnson and Wood (1996:563) viewed, and commented upon the integrated logistics (and supply chain management (SCM)) concept evolution thus: "In the 1980s, logistic strategies could best be thought of in terms of independent boxes (storage centers) linked together by transportation services. In the 1990s the model is shifting to that of a pipeline, with emphasis placed on integration. By the late 1990s, the more appropriate model will be the hose, where product velocity is increased and the system is flexible enough to respond quickly to changing customer demands."

4.4.3 Corporate Status And Information Technology (IT)

In 1984 Roy D. Shapiro published his article "Get leverage from logistics" in which he demonstrated how logistics could contribute favourably to/in areas such as product innovation, customer service and, cost leadership. Later that year, Graham Sharman published his article "The Rediscovery of Logistics" in which he identified the need for top management to recognise the importance of logistics to the enterprise/corporation. Sharman (1984) also provided evidence of the increasing role of logistics in business strategy and planning.

In the mid to late 1980s and 1990s logistics transposed into being information led and dominated. Alan Judson Stenger (1986:67) classified logistics information systems into four groups: -

1. Transaction systems;
2. Short-term scheduling and inventory replenishment systems;
3. Flow planning systems; and
4. Network planning and design systems.

Whilst the progress in information systems has been technology led (both hardware and software) the basic evolutions within each for logistics were:-

• Transaction systems: basically from batch processing to real time data which involve data bases with query/retrieval facilities to EDI and microcomputers (although these are not an efficient way of communicating intrafirm as most logistical transactions need to be accessed by other departments in the firm). The advancements now are for data capture devices that will read the whole range of alternative types of data inputs like barcodes, etc., and stardardisation of the EDI protocol (i.e. common data formatting and transmission standards).

• Short-term scheduling and inventory replenishment systems: obviously these aid inventory replenishment, production scheduling, warehouse labour planning/scheduling, vehicle loading, vehicle routing and shipment consolidation. As Stenger (1986:75-76) warned: "The main constraints on these systems continue to be the quality of the input information and the temptation to override the schedule. Input data come from transaction systems, which must provide accurate, up-to-date information. With regard to overriding the schedule, the Japanese have shown us, with their just-in-time approaches to inventory and production management, the benefits of developing an environment in which

schedules do not need to be revised constantly, for too much noise or nervousness in the system creates its own havoc."

"The other key requirement for success with automatic short-term scheduling systems is that sufficient resources - inventories, manpower, and equipment be available for scheduling."

• Flow planning systems: these seek to coordinate supply with demand to utilise a fixed logistics network as efficiently and effectively as possible. They consist of: forecasting; allocation of work and materials; and time-phased flow schedules. The end aims are to reduce: individual process and movement lead times; production changeover times; as well as stabilising demand schedules.

• Network planning and design: these evolved from early facility/site location approaches through simulation methods to optimisation models. Regular (i.e. annual) reviews of the total network is a feature offered by these systems with the informed analyses of any variances that may manifest in an overall plan.

Naturally, the ideal logistics information system will arise from the integration of all four of the above areas such that accurate and precise data is entered only once and is then transferred electronically throughout, making it accessible to all. The data capture/recording and designed statistical (i.e. ratio) outputs/analyses would supply marketing, accounting and operational information and benchmarks, together with the routine decisions being taken automatically/electronically within the constraints and conditions laid down within the organisation's policy using aids like On-Line Analytic Processing (O-LAP). To confirm this, Drucker (1988) predicted that major corporations were on the threshold of shifting from a command and control structure that had persisted for over fifty years to an information based organisation consisting of knowledge specialists. The organisation of the future, according to Drucker (1988:45) will be: "... an organization composed largely of specialists who direct and discipline their own performance through organized feedback from colleagues, customers, and headquarters."

4.4.4 International Integration

Generally, containerisation has standardised the mechanical handling, storage and overall efficiency of much international/global transported freight. For such freight, during the 1980s, the old system of employing individual/separate Transporters, Carriers, Forwarders, Exporters, Expediters, and other agents etc., with the inherent difficult communications, responsibility pinning and particularly, the separate profit margin to each, came to be reviewed. (This latter point is similar to the dual commission argument that existed for Jobbers and Stock-Brockers which made British share trading more expensive; these have combined now thus charging a single (i.e. cheaper) commission.) The result of the reviews has been the mergers, take-overs/acquisitions, partnerships, alliances, collaborations, etc., of many of these individual/separate service providers, into one organisation, carrying out the whole of these functions. The responsibility and

communications (chiefly *tracing*) have thus improved together with - what was the original principal objective - a cheaper total cost for the handling of international freight. The speed, responsiveness and general service levels have improved as an outcome too.

However, the amalgamation of all the above separate activites/functions within one organisation has only really created international region-wide (or at best continental-wide) integrated carriers. There is a serious lack of truly *global* logistics carriers; and commerce (i.e. businesses) would like some truly global carriers, because at present commerce is still having to deal with more than one carrier to cover the whole/total globe. Other international logistics issues/matters that require attention are: the different document standards that exist from place/area to place/area; the integrated/connected and protocol aspects of IT/IS; evidence exists (albeit anecdotal) that in the sea-shipping arena a cartel is in operation; and, the differing cultures, all of which can have an adverse impact on both *time* and *cost.*

4.4.5 Partnerships/Strategic Alliances

It is generally held that the evolutionary way of developing a partnership and beyond (whilst building-up trust *en route*) follows the path of attaining various levels as below:-

from the:	'traditional/transactional/adversarial stance'
via the status of an:	'approved supplier'
becoming a:	'preferred supplier'
entering a:	'partnership'
and via a:	'strategic alliance'
reaching:	'vertical integration'.

Or, the US model sequence is: from (i) 'Open Market Negotiations' which are price-based discussions and adversarial relationships; via (ii) 'Cooperation' which means fewer suppliers (although in reality this may mean fewer 'points-of-contacts' as a re-shuffling of suppliers within tiers/echelons occurs - i.e. a form of outsourced purchasing) and longer-term contracts, and (iii) 'Coordination' which means WIP linkages, information linkages and EDI exchange; to (iv) 'Collaboration' (i.e. partnership(s)) which means technology sharing, joint planning and supply chain/network integration.

The popularity of third party logistics (outsourcing, or as some modern protagonists prefer to call it *alternative resourcing*) resulting from concentration on core skills by major corporations led to strategic alliances for the exploitation of integrated logistics. Bowersox et al (1989:213) described it thus: "A strategic alliance is **a business relationship in which two or more independent organizations decide to work closely together to achieve specific objectives.**" They (Bowersox et al, 1989:218-222) then classified three types of strategic alliances:-

Partnership Agreement: the most informal type of a strategic alliance;

Third Party Arrangement: which is more formalised and is expected to last longer than the

typical partnership agreement; and

Comprehensive or Integrated Service Agreement: the most formalised type of strategic alliance and consisted of a provider for the whole/fully integrated services - such a provider is sometimes called, or referred to as, a **logistics utility**.

For a successful strategic alliance to be achieved Bowersox et al (1989:224-228) offered guidelines for issues to be clarified with a logistics utility provider with respect to the following six aspects:-

Channel Perspective; Selective Matching; Information Sharing; Role Specification; Ground Rules; and Freedom To Exit.

A provider that conducts extra value-added activities or services over and beyond the essential basics *contracted for* by the client/customer is said to be furnishing *tailored services/logistics* (Bowersox et al, 1989:233-247). The basic justifications for external procurement of tailored services/logistics were: (i) specialisation; (ii) risk reduction and (iii) creativity. Typical tailored value added services/logistics can be categorised into four groupings: (a) customer based; (b) promotion based; (c) manufacturing based and (d) Just-In-Time (JIT) based. From their research, Bowersox et al (1989:246) summed-up tailored services/logistics thus: "To a significant degree, the popularity of outsourcing tailored service arrangements is directly stimulated by managerial emphasis in shipper firms on downsizing and flattening organization structures. ... They clearly expressed a desire to achieve the benefits of a vertically integrated organization without the burden of ownership. The use of external relationships to gain strategic leverage is analogous to de-verticalization of industry." What could be achieved, or created, from the above description is a monolithic rationalised (fewer supplier nodes) distribution channel that could effectively become a super organisation of cooperative vertical asset management.

For a respectable treatise on outsourcing see Quinn and Hilmer (1994). Other aspects of, and the development of logistics alliances are covered by Van Laarhoven and Sharman (1994:49) where they commented: "The success of logistics alliances means that they are poised to become a building block of the "network economy" - a system in which companies will increasingly focus on their core competences and outsource other activities to service providers that can execute them more cheaply, more efficiently, and/or more effectively. Since companies need to retain control of the outsourced operations that are closely linked to in-house tasks, alliances based on partner-like relationships are vital."

In the 'factors of production' (business to business) markets, manufacturers started to modularise components (i.e. have higher level of assemblies being supplied) and rationalise their supply bases - that is having fewer suppliers or, outsourcing purchasing, in a way/manner that changed the *shape* and/or *tier structure* of the logistics network which resulted in fewer 'points of contacts'. This was called "Lean Supply" (Lamming, 1993:178-211). Terms that emerged to describe these relationships were *co-designer*, *co-maker* (Merli, 1991) and/or *co-manufacturer*.

Probably the first ever example of vertical integration was the beef meat and corned beef supply chain, from early to mid this century, wholly owned by the Vestey family (who were the founders and establishers of the Dewhurst Master Butchers High Street multiple). They owned cattle ranches in Argentina, where they bred and reared the cows; they slaughtered their cattle and processed the beef, exporting it to Europe - principally Britain, supplying their own, and other, shops with beef flesh and carcasses, corned beef and many other meat and animal products.

4.4.5.1 Relationships

Hines (1994:5-6) referred to Peter F. Drucker when expounding the importance of relationships by quoting him when he wrote: "Drucker (writing in 1982) stated: "Nowhere in business is there greater potential for benefiting from ... interdependency than between customer firms and their suppliers. This is the largest remaining frontier for gaining competitive advantage - and nowhere has such a frontier been more neglected."" Clearly, to attain the maximum benefit from tailored services/logistics and reduced supplier bases (which themselves may/might offer value adding - and/or other - services) there must be in existence good cooperative relationships. Much research has been carried out and written about relationships in the buyer/seller (used in its broadest sense for business-to-business or industrial markets) and logistics arenas with all the researchers and authors/commentators/writers expounding the importance and benefits attached to it. Becoming common these days are 'terms of business' like: "open book accounting"; only paying a prescribed "management fee"; "sharing information"; and, "paying on-time" for goods and services. Although many have advocated that in *true* relationships/partnerships any achieved savings (i.e. reduced costs) in the supply system are (or should be) shared amongst the participants/members - known as "*gain share*", there is, however, evidence to the contrary - see Extract 4.2 (Poirier and Reiter, 1996:24).

Concomitant with relationships is 'trust' (not 'trussed' where one party 'ties-up' the other party!) which is an *essential* ingredient. From an interview with Victor Fung, Magretta (1998:108) recorded: "We come in and look at the whole supply chain. We know the Limited is going to order 100,000 garments, but we don't know the style or the colors yet. The buyer will tell us that five weeks before delivery. The trust between us and our supply network means that we can reserve undyed yarn from the yarn supplier. I can lock up capacity at the mills for the weaving and dying with the promise that they'll get an order of a specific size; five weeks before delivery, we will let them know what colors we want. Then I say the same thing to the factories, "I don't know the product specs yet, but I have organized the colors and the fabric and the trim for you, and they'll be delivered to you on this date and you'll have three weeks to produce so many garments."" Relationships take/consist of many forms and as such are diffuse and multi-dimensional because they are usually socially constructed and therefore unrecorded/untabulated. Research is needed here to ascertain how trust and relationships should be measured/quantified?

Once, when we wanted to test the concept we are promoting, we asked a retailer what would happen if we entered into a partnering arrangement and found one dollar of new savings. Our somewhat perplexed retailer needed elaboration. We replied that we wanted to know where a single dollar we might find from a value search in our interactive system would go? The quick reply was "On the shelf." When we asked why, the retailer replied that twenty-five cents of the dollar would be put into profits. The balance would enable the retail firm to discount the cost of the item. This would mean that more customers would come to the store to buy the lower-priced product. That action would draw more sales of the product through the system. In addition, the customer might buy other items in the store, and store revenues would be enhanced.

We agreed with the traditional logic of that argument but had to ask, "Then what are we to do with the other four dollars?" Our customer wanted to know about these "other dollars." We continued by explaining that we had actually discovered five dollars of savings in the system, but we had only offered one of them to see what its fate would be. We pointed out that once we found that the entire savings went to the retailer and consumer, essentially helping only the retailer, we had little incentive to bring the other four dollars to the table. Our customer quickly replied that if we helped to discount the product we made and offer that discount "at the shelf," we would move more product together and make additional profits on the extra volume.

Our retort was that if we gave the consumer fifty cents of the first dollar and kept twenty-five cents for each of us to build more efficiencies into both of our organizations, we would have created the incentive to find - and share - the other four dollars. The ultimate consumer would save money on the purchase, but the system would have retained a portion of the savings for other investments. Because the first dollar was shared with the supplier, retailer, and consumer, we would now have an incentive to dig out the other four dollars. The fate of that first dollar would have set a positive tone for working together on system improvement, rather than simply making cost concessions.

(Taken from: Poirier and Reiter, 1996:24)

Extract 4.2 The Fate of a Dollar Saved

4.4.5.2 Traceability

For certain products (particularly within the aerospace industry) a requirement exists for the traceability (i.e. the history) of materials used, processes employed, components, products and equipment. Coupled with this is the necessity for records to be kept for components with respect to shelf-life, flying hours in service, any refurbishment and/or reconditioning/alteration undergone/undertaken. Clearly, it is understood that such critical aspects as air safety and airworthiness attached to such supplies calls for these stringent measures; and should an incident/accident occur the 'supply chain/train/network' of materials, processes and storage background(s) must be easily delineated in order to: (i) correct the fault/error/mistake; (ii) establish the magnitude of any remaining/existing problem attached to the original finding(s) and; (iii) locate and put right the other possible complications elsewhere.

The UK MoD has a *traceability clause* (similar to the aerospace industry above) in most of its supply contracts too. The defence supply industry has to comply with this *specification* and retain the records/data/information of such components, products and equipment for a period of 7-10 years. For the UK to sell her beef and beef products (lamb and pork in some cases too (see Anon., 1997:61)) abroad also requires traceability data relating to the cattle/herd source/history because of the bovine spongiform encephalopathy (BSE) scare. There is a very strong likelihood that the complete traceability of other livestock (particularly, sheep and pigs) will be necessary/mandatory soon too. Obviously, computerisation is a huge aid and enabler for storing/retaining and retrieving such data. With the demand for ever increasing quality needs, and because of pending EEC 'product liability' legislation, traceability by means of an identification and registration system governed by regulations could become a *standard back-up* for most products. Could this be another function and/or service that the "logistics' umbrella" will embrace/provide?

4.4.6 Logistics Mapping Tools

As a result of all the above contributors (pioneers/academics/practitioners) to the knowledge of logistics, the 1990s possesses many techniques to analyse what is happening in any part of, or the whole of, a logistics value stream. Now, to analyse and understand logistics chains/networks/systems a variety of mapping tools are available. Some of these supply chain/network management mapping tools have been described, used and demonstrated by Scott and Westbrook (1991) and Fisher (1997a). Hines and Rich (1997) have explained and listed seven such value stream mapping tools; they were:-

1. Process activity mapping: which originated from industrial engineering;
2. Supply chain response matrix; the origins being from time compression logistics;
3. Production variety funnel: which came from operations management;
4. Quality filter mapping: a new tool;
5. Demand amplification mapping: which came from system dynamics (Forrester, 1958 and 1961);

6. Decision point analysis: which came from efficient consumer response (ECR) logistics; and
7. Physical structure mapping: a new tool.

By the use/application of many of the mapping tools above, the development of quick/rapid (efficient consumer) response logistics took place in the period from the mid 1980s to the 1990s. Its evolution and description will be recounted in chapter 6.

4.5 Stages Of Business Logistics Evolution

There is no doubt that technology has been a great enabler, accelerator and promoter of commercial logistics throughout the ages. Firstly, the technology relating to transportation developments and progress in terms of modes/types, speed and bulk haulage. Secondly, the technology relating to communications (telegraph, telephone, radio and facsimile, etc.) advancements and speed. Thirdly, the technology relating to materials handling like: aqueducts and piping; packaging - primary and secondary - barrels, crates, tin-cans, built-in dispensers and decanters, etc; cranes; conveyors, escalators and lifts/elevators; fork-lift trucks and palletisation; and containerisation. And fourthly, the technology relating to computerisation and electronic data capture (barcoding) and transmission - in terms of: modelling and optimisation exercises; real-time data; on-line automatic analyses/interpretations (O-LAP) and decision taking/execution according to pre-set/programmed rules (i.e. triggered decisions/actions); and 'screen to screen' communications and interactions.

4.5.1 The Framework Of Richard Francis Poist

R.F. Poist (1986) developed a framework for the evolutionary development of logistics thought, together with an interesting discussion of the systems approach. He categorised logistics into three eras: **Prelogistics** (pre-1950s) where the emphasis was on designing transport systems; **Logistics** (1950s, 1960s, 1970s) with an emphasis on designing logistics systems; and **Neologistics** (1980 and beyond) which attempted to fit logistics sub-systems into broader systems (e.g. the enterprise as a system). As can be seen, he purported that the logistics system perspective has broadened (Poist, 1986:61): "... during these eras, we witness the continual broadening of the systems perspective - from a transportation perspective to a logistics perspective to an enterprise perspective". In his sequel paper Poist (1989) advocated an even wider brief for the Neologistics era, that of the Total Responsibility Approach. This again encompassed fitting logistics sub-systems into the broader system of the enterprise and included 'the enterprise and society as an interactive system' taking on board social responsibilities, green issues and sustainability matters/factors, etc.

4.5.2 The Framework Of William D. Harris And James R. Stock

In their historical study, Harris and Stock (1985:436-437) concluded that marketing and distribution are not independent disciplines. Furthermore they purported that the dependency of marketing and distribution has passed through four periods. These periods being (Harris and Stock, 1985:422):-

(1) The period of conceptualization - The constucts of distribution, communications, marketing, utilities, and others, were being reformulated and/or developed for the first time giving rise to the foundations of the discipline of marketing.
(2) The period of integration - Marketing & distribution came to be viewed as being part of the same discipline.
(3) The period of dis-integration - Distribution separated from marketing as the "functionalist" approach declined in importance.
(4) The period of re-integration - Marketing & distribution have entered an era of re-integration.

4.5.3 The Framework Of Graham C. Stevens

Considering a linear system of material input at the front-end and the provison of customer service at the back end, Stevens (1989) gave four stages as the evolution of the route to full integration: from baseline; through functional integration; and internal integration; to external integration.

- Stage one: the baseline stage was one where the five internal tasks of Purchasing, Material control, Production, Sales and Distribution operated independently of each other with very little trust between them, i.e. discrete decisions with responsibility lodged in each of the task centres. The result was one of sub-optimisation where inventory buffers (six in all) were piled high between each function in the pursuit of each isolating itself from the rest, i.e. a lack of control *across* the supply chain function because of organisational boundaries that prevented coordinated decisions.
- Stage two: the functional integration stage was where an internal (i.e. inward flow) rationalisation took place resulting in having only three management areas: Materials management, Manufacturing management and Distribution. Now only four inventory buffers were apparent and the buffers at the raw material end were smaller than the two at the Distribution end, probably because: holding finished goods inventory was still seen as the way of providing good customer service, i.e. speculation - having the end products available on the shelf or in the warehouse; and use of the '*push*' philosophy. So this had an emphasis on cost reduction primarily and *not* on the total preformance achievement.
- Stage three: the internal integration stage was where the management of internal material flow became prevalent (by the aid of enterprise-wide MRPII and/or DRPII) which provided a coordinated 'end-to-end' planning framework. The situation now was such that no buffers existed between adjacent management areas; inventory existed at the beginning and end only, i.e. two inventory buffers.

- Stage four: the external integration stage would be one where material flow management throughout the entire system comprising of Suppliers, Internal supply chain (i.e. the company) and Customers took place. As Christopher (1992:15-16) described it: "Finally, stage 4 sees the company as part of a pipeline that achieves optimal value added in terms of each customer's requirements whilst maximising total supply chain profit." The ideal position being one where *no* inventory buffers exist at all.

4.5.4 Summary Of The Key Evolutionary Aspects Of Commercial Logistics

Event/Incident/Technique/Revelation	Period/Time
The total world population comprised hunter-gatherer bands	pre 10 000 BC
- Nomadic	
- Live off the land	
- Seasonality	
- Portability of items	
- Use of beasts of burden	
Stable/concentration of populations	circa 5000 BC
- Farming communities (both arable and livestock)	
Large storage arrangements for grain to last between harvests in Egypt	circa 3000 BC
Market villages and/or market towns	
- Centralised exchange points (hub & spoke)	
Early means of showing ownership quantities of livestock	
- Clay pouch/purse containing equal number of stones	
Most bulk transport as such was via rivers/canals	
Specific trade-routes	
- Camel trains/caravans, etc.	
- Dispersion and/or concentration of people (demography)	
Sea-going sailing ships first built by the Egyptians	circa 1500 BC
The Romans	circa 200 BC-700 AD
- Their road systems/networks aided commercial trade and travel	
The Crusades	circa 1090-1300 AD
- Established transport and supply channels in central southern Europe	
The *Etape* system	circa 1480s
- Centralised provisioning hub & spoke centre (storage, sale and distribution)	
Transatlantic trade	circa 1520
Branding of wooden crates by the sender/supplier	
Smuggling and contraband trade/sales	1600-1820
- Ease of handling	
- Concealed storage	
- Geographical postponement - proximity placement(s)	
- Night-time movements	
Languedoc Canal opened	1681
Dispersed population in USA versus urbanised population in Britain	early 1800s
- Demographic changes	
- Moved away from agricultural based economy	
- Moved towards manufacturing (in certain concentrated regions) based economy	
Emergence of the railway(s)	circa 1830s
- Switch from river/canal barge freight to rail-freight	

Event/Incident/Technique/Revelation	Period/Time
Steamships became established	circa 1840s
Three kinds of selling	
- Sale by bulk; sale by sample; and sale by description	
Railway management	mid 1850s
- The land/distance geographical problem was overcome to some extent	
- Development of accounting and performance ratios (specific and business)	
In the US, inauguration of the 'Pony Express'	1860
Suez Canal opened	1869
Evolution/emergence of middlemen/distribution channels	circa 1870
Development of the ratio of 'stockturns'	
Corinth Canal opened	1893
Logistics/distribution first examined in *scholarly* writing(s)	early 1900
Analysis/study of costs and factors affecting distribution of farm products in the US	1901
Trucks/lorries and cars (internal combustion engine) became familiar	circa 1910
Panama Canal opened	1914
Marketing/logistics concepts	1916
- Time, place and possession utility	
- Demand creation for sufficient volume to make production & distribution profitable	
- Designed channels of distribution	
- Balancing of supply and demand	
- Service (direct and collateral)	
Logistics concepts	1920
- Quality (via grading)	
- Recognition of the lead-time factor (and its importance)	
- Population-distribution analyses (demographic density/size clusters)	
Vertical integration shown to have better stockturns	1921
Concentration versus dispersion relevancy in movements of inventory	1922
- Importance of transport costs	
- Control over the market (hinting power)	
Development of commercial passenger air transport	mid 1920s
Wholesale operation management theory and practice	1926
Comparative cost ratios for production and distribution	1927
- The recognition that 67% of the retail price was to cover distribution	
- Logistics costs increased/rose in expanding markets	
- The need to differentiate production and distribution costs	
- Call for the same work/method-study regard to distribution as given to production	
Response time comes to the fore	
- A price premium can be charged for speed	
- Supply/buy in smaller quantities	
- Can cope with style changes	
- Geographical postponement (local stocks)	
The Great Depression	1929-1934
- Distribution described as being in chaos	
- A call for the understanding of the 'primary forces'	
The Space Element and the use of 'eye photographs' as an analytic tool	1934
- Mapping the total material flow from produced via intermediaries to the consumer	
- Spatio-temporal aspects/interactions	

Event/Incident/Technique/Revelation	Period/Time
The emergence of 'customer satisfaction'	1935-1945
- Focus on cost efficiency	
- Broad scope of physical transfer of goods in a trade channel: intrafirm and interfirm	
- Much designing of transport systems	
Aspects of purchasing began to be studied/analysed	1947
- The importance of purchasing and its principles and practices	
The cost of distribution was pointed out to be 50% of the retail price	1950
Traffic/transport management came to the fore	
- Services and transportation were linked	
Recognition of similarities between military and commercial logistics	1951
- First use of the label 'Business Logistics'	
- A recognition that there was a *lack* of both a theory and a systematic approach	
Palletisation introduced for materials handling	circa early 1950s
- Multi-product handling ability	
- Versatile	
- Needed fork-lift truck for shifting/moving	
Physical distribution was described as 'the other half of marketing'	1954
- A call for the intellectual understanding of physical distribution	
The emergence of air freight and its role was defined	mid 1950s
Breakdown of the 'cost of manufacturing' was approximately:-	
- Labour 55%; materials 30%; and overheads 15%	
- From now on the material proportion steadily increases	
Industrial dynamics and demand amplification emerged as a science	1958
- The mapping of changes/impacts along the whole supply chain	
Rhocrematics proposed as a name/title for the field of physical distribution	early 1960s
- A semantics problem existed about what the general field should be called?	
The emergence of materials management (inventory control)	
- The impact on the asset base	
- Tied-up capital and opportunity cost(s)	
- Logistics and materials management were linked	
Composition of the shops on the high street began to change	
- From homogeneous product shops to heterogeneous product supermarkets	
- One stop shopping concept	
Again, the fact that distribution cost 50% of the retail price was reiterated	1962
- Call to focus/concentrate on cost reduction in physical distribution	
Postponement of speculation concept was explained	1965
Containerisation introduced widely	
- Standardised 'boxes' dispensed with lashing and other stowage problems	
Logistics and promotion became treated as sub-functions of marketing	1966
The 'total distribution concept' emerged	
In the UK, a swing in 'power' over the supply chain, from manufacturers to the retailers	
A finding that: one member of a distribution channel usually dominated its behaviour and practices	) 1968)
The systems approach and the widespread use of computerised operational research in physical distribution management design and optimisation (vast use of modelling)	
Purchasing/procurement and logistics became linked	
Customer service aspects/issues became prevalent again	
The Japanese started to develop JIT (space saving was a prompt/stimulus)	late 1960s

Event/Incident/Technique/Revelation	Period/Time
High street retailers moved 'stock rooms' from stores to 'out of town' locations	c.1969
- High street store space was expensive, why use as a warehouse?	
- Out of town space was much cheaper	
- Birth of the composite distribution centre	
- Rationalisation of the supplier base began	
Focus on continental distribution systems	early 1970s
Barcoding of retail products/items introduced	
- Quicker flow of 'checking-out' customers in supermarkets	
- Computerised inventory/stock management	
- Batch up-dating of computer data	
Materials Requirements Planning (MRP) introduced	
- Encouraging some functional integration	
The potential of information systems assistance to logistics was perceived	
'Hub & Spoke' concept used for air freight/travel coupled with the use of non-peak times	
Strong focus on linking SERVICE with logistics	mid 1970s
Focus on designing logistics systems	
Focus on international distribution systems	late 1970s
Ground work was done for Manufacturing Resources Planning (MRPII) and Distribution Resources Planning (DRPII) followed shortly after	
- Control of manufacturing and distribution systems	
- Encouraging internal integration	
- Replenishment cycle reductions were sought	
Recognition that logistics was important to corporate strategy	
The drive to reduce inventory throughout the system/chain/network began	
Distinction made between supply "PUSH" systems and demand "PULL" systems	
JIT was beginning to spread worldwide	early 1980s
The emergence of Optimised Production Technology (OPT)	
Relationships and trust were seen as important to achieve effectiveness	
Logistics was classed as a function that was 'information led'	
Logistics information systems were classified into four groups:-	
- Transaction systems	
- Short-term scheduling and inventory replenishment systems	
- Flow planning systems	
- Network planning and design systems	
Information sharing along the whole supply chain	mid 1980s
- Real time data up-dating	
- Encouraging external (i.e. channel) integration	
Partnerships and alliances within logistics	
- Outsourcing logistics became fashionable	
Development of the "Quick/Rapid Response Logistics" system (see chapter 6)	
Benchmarking logistics became fashionable	
Lean production and then lean supply	late 1980s
- Supplier base rationalisation	
Continental integration of logistics	
Year-on-year unit cost reduction became the *norm* in the business to business market	
Breakdown of the 'cost of manufacturing' was/is approximately:-	1990s
- Materials 57%; overheads 25%; and labour 18%	
Geographical (or spatial) integration of logistics	
Sustainability and reverse logistics principles were incorporated into the system(s)	
Traceability of products' source and progress through the system	
The whole panoply of logistics mapping tools were assembled	

4.6 The Way Forward

Clearly, as Gattorna and Walters (1996:108-109) stated: "The objective of a supply chain concept is to synchronize the service requirements of the customer with the flow of materials from suppliers such that the apparent contradictory situation of conflicting goals of high customer service, low inventory investment and low operating costs may be balanced (or optimized)." From their research surveying 117 North American firms regarding logistics strategy, structure and behaviour, Bowersox et al (1989:i) stated: "The research provides overwhelming evidence that a small number of leading edge North American firms enjoy a superior level of logistical competency. These companies use logistics as a competitive weapon to secure and maintain customer loyalty. They are more responsive and flexible, are more committed to their customers, are more aware of their results, work more closely with their suppliers, are more likely to embrace technology and are more involved with their firm's strategic direction." Guidelines for planning (the strategy formulation of) the achievement and improvement (i.e. structure and behaviour) of the above critical attributes via integration were given by Cooper et al (1992:18-21):-

1. Create an open and cooperative corporate culture for better integration of functions.
2. Communicate the mission and strategic direction of the firm to all employees. Let them know where they fit.
3. Make the strategic plan part of day-to-day operations, a living document rather than one which is stored on the shelf.
4. Let your inside customers know what value-added services Logistics can deliver.
5. Establish close and recurring relationships with customers beyond the sales call.
6. Work closely with suppliers to plan for future customer needs.
7. Logistics should begin now to look at least five years into the future and do its own strategic planning if it is not already doing so. Then Logistics will be prepared to actively pursue being included in the corporate planning process and ultimately to participate in that process.

To sustain a future competitive advantage, an enterprise will require a flow of evolving managerial thinking, routines and/or capabilities, particularly in *response* and *replenishment*, by its logistics component. Ideas like: 'supplier associations'; 'consortium purchasing'; ''end to end' information management' via *state-of-the-art* technologies; 'shared asset collaborations'; 'benchmarking partnerships'; and other 'club approaches' with their shared information/benchmarking data, will help to stimulate new concepts and novel ways forward seeking the goal of successful, *accurate* and *timely* demand matching.

4.6.1 Envoi

Poirier and Reiter (1996:31) have commented/written: "Retailers, struggling to keep customers, are focusing on cost reduction and want to move traditional expenses back through distribution to the manufacturers. Manufacturers, wanting to maintain margins,

look for potential improvements that can be shared downstream with their customers and look upstream for concessions from their suppliers. Because the fruits of these efforts are continually passed to the ultimate consumer, supply chains and their constituents run the risk of becoming involved in a zero-sum game. Under these conditions, in which all savings go out of the system, margins fall for all members of the network. A better system looks for total systems savings that are shared between chain members and the consumer. Much work will have to be accomplished to create this better world." Year-on-year unit cost reductions are both the *norm* and are *expected* these days.

During both the initial inquiry for this research and the historical evolution work certain concepts/theories, principles and techniques constantly recurred. So, in the next part of this thesis some pertinent and basic theories appertaining to logistics in general and the quick/rapid (efficient consumer) response systems in particular are explained.

5. THEORY

"The lowest form of thinking is in the bare recognition of the object. The highest, the comprehensive intuition of man who sees all things as part of a system."
Plato (427- 347 BC)

Below, in this chapter, are the key and pertinent logistics and response theories that have recurred, and been referred too, many times in the earlier parts/chapters of this thesis and are cogent to this research. An explanation and illustration of each is given to describe the philosophy behind it and the manner of 'how it works?' Following this, in Chapter 6, it will be shown how these theories are amalgamated and, with the use of computing technologies, together form a *system* called 'quick response logistics'.

5.1 Introduction

Distribution systems exist as subsystems within the confines of the larger corporate system, although they may not be identified as separate departments. The ratio of physical distribution costs to sales is significant in some industries, at circa 25% in the food industry and 22% for the chemical, rubber and primary metal industries. Each interface of speciality interest is an area of potential conflict. Marketing may disagree with Sales about the timing of campaigns/promotions. Purchasing could press for larger order quantities to take advantage of quantity discounts, whereas Inventory Management warns against the increase in holding costs. Longer production runs with fewer set-ups are opposed by the need to find storage space for the larger output prior to its distribution. Large stocks in warehouses are fine for Customer Service because the lead time prior to shipment is lower, but what about the holding costs? Sales pushes for a greater range of products against the caution of Manufacturing that diversification complicates production. A new packaging design could be favoured by Marketing, Sales and Purchasing while being opposed by Production, Planning, Warehousing and Inventory Management. Unity must be achieved, preferably through management orientation and an environment for systems thinking. Coordinated strategies and actions are essential.

In his paper, Kanbrovich (1939) said: "There are two ways of increasing the efficiency of the work in a shop or enterprise, or a whole branch of industry. One way is by various improvements of technology - that is - new attachments for individual machines, changes in technological processes, and the discovery of new and better kinds of raw materials. The other way, so far much less used, is by improvement in the organisation of planning and production."

A good example of the effect of organisation and planning is in logistics and material management. New, faster, smarter and more versatile machines and computers have increased efficiency, while mathematical techniques for organising material flow have had a comparable effect. However, this is not the complete solution. Profitable

production and logistics depend on both an effective policy and efficient operations. In other words an effective strategy is coupled with efficient tactics. (Beware of sub-optimisation: an attempt to optimise a tactical segment of a problem - e.g. part of a logistics system - without regard to the solution's total effectiveness. Sub-optimisation within the total system weakens the coordination of the system.) For instance, Magee (1960:89) advised: "More often than not, the challenge posed is to the system as a whole, not just to the particular part or function where trouble is most obvious." A brave deviation from the norm, illustrating proactive logistics decision making to preclude sub-optimisation, is cited by Johnson and Wood (1993:12), where General Motors decided to charter Boeing 747s to air freight the Cadillac Allante body, designed and manufactured by Pininfarina in Italy, to Detroit. Cheaper ocean-going freight was determined to be sub-optimal because the capital tied-up in pipeline inventory for air freight was $4.5 million - 150 bodies - as compared to $30 million - 1 000 bodies - if General Motors had decided to ship the bodies by sea.

5.1.1 Nodes And Links

One approach of analysing logistic systems is 'nodes' and 'links'. As Coyle et al (1992:24) wrote: "The nodes are established spatial points where goods stop for storage or processing. In other words, the nodes are plants and warehouses where the organization stores materials for conversion into finished products or goods in finished form for sale to customers (equalization of supply and demand). The other part of the system is the links, which represent the transportation network connecting the nodes in the logistics system. The network can be composed of individual modes of transportation (rail, motor, water, pipelines) and of combinations and variations ... " Examples of processes conducted at nodes could be: sorting out; accumulating; allocation; and assorting (Stock and Lambert, 1993:76-77), as well as other 'value adding' postponement activities. The most common type of node-link pattern is the arborescent (diverging) kind where the number of nodes in each echelon increases as progress is made downstream until the customer(s) is/are reached, and the flow ends. Similarly, from the upstream side, tiers or echelons are evident with a converging pattern to a 'focus node'. By using nodes and links in more detailed arrays, patterns of supply systems can be categorised into four levels (adapted from Harland, 1996):-
(1) internal; (2) dyadic; (3) supply chain (which is linear); and (4) supply network, probably with a 'focus node'. Level (1) is the internal supply arrangement(s) that integrates business functions involved in the flow of materials and information from in-bound to out-bound ends of the business. Level (2) is the management of dyadic or two party relationships with immediate suppliers like a *co-maker, co-operator, partner* or *close ally*. Level (3) is the management of a chain (i.e. string) of businesses including a supplier, a supplier's supplier, a customer and a customer's customer. If level (3) is not wholly owned by one party (and today this is usually the case, i.e. *not* vertically integrated), then usually a powerful player in the chain *manages* the chain by taking a

sequence of decisions which moves the chain in the *desired direction* and to the *desired behaviour*. Level (4) is the management of a non-linear supply network of interconnected businesses (i.e. nodes) involved in the ultimate provision of product and service packages (or bundles) required by end customers. Level (4) usually consists of converging and diverging patterns and strategies. These four levels of supply systems are illustrated diagrammatically in Figure 5.1.

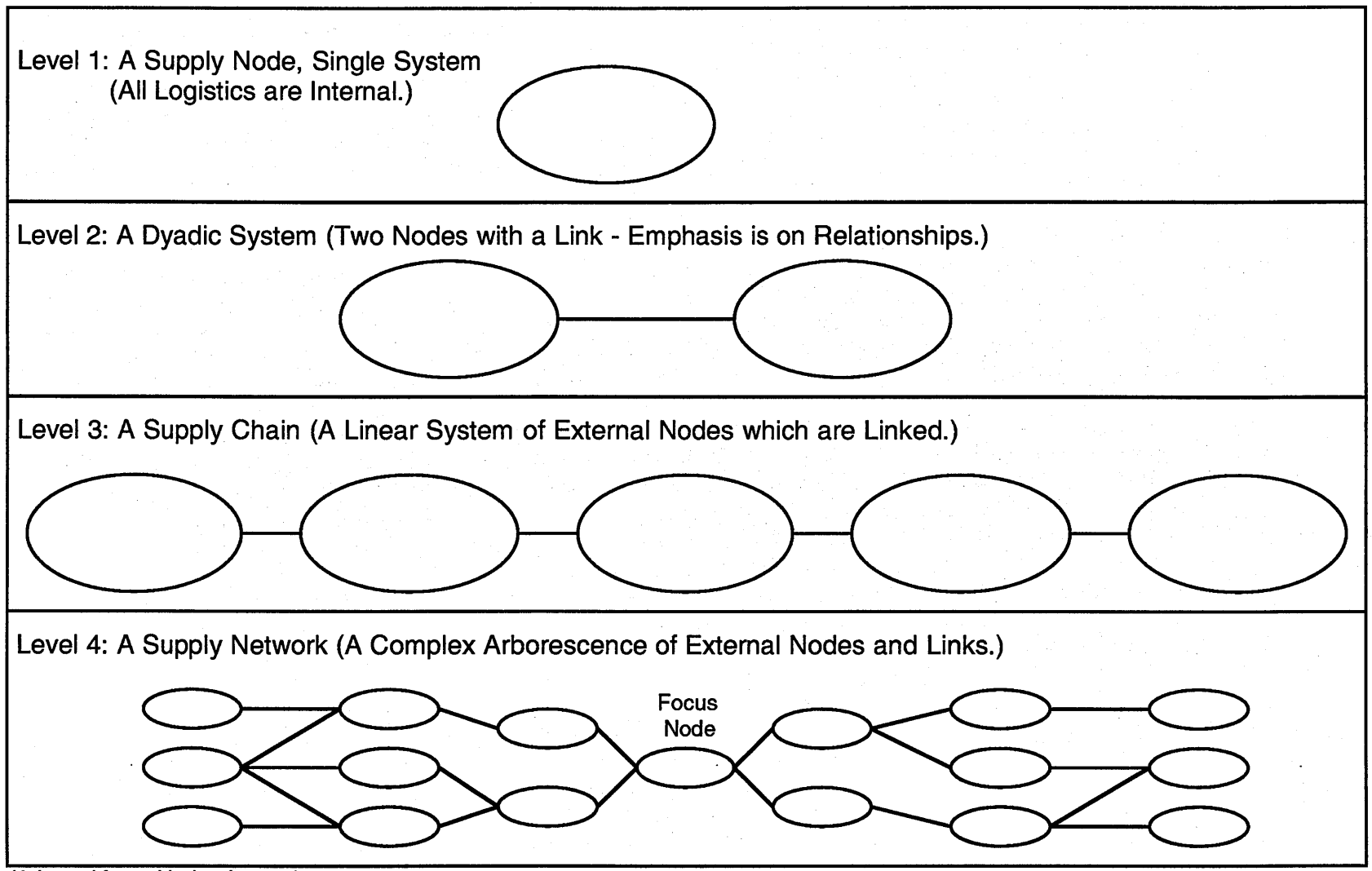
In their work-in-progress paper, Faria and Wensley (1997) offered some characteristics that separate supply chains from supply networks, i.e. level (3) and (4) above. They stated that the two levels have different *solution generating heuristics* and generally whilst supply chains are managed throughout, networks are not - for these it is a matter of 'managing in them'. Their comparison is tabulated below in Table 5.1.

Supply Chain Management	Network Management
Economic efficiency	Socio-economic rationality
Common goals	Semi-autonomy
Central actor: Key customer	No centrality
Customer orientation	Network identity
Value adding strategic opportunity	Network position opportunity
Collective "intentions"	Collective "action" and emergence
Normative emphasis	Descriptive emphasis

Table 5.1 Supply Chain and Network Managements Compared

Within the nodes and links of a network, there exists a governance structure, and there can be problems in defining or *knowing* the 'rights and obligations' of each node (or party/member). The unknown limits of the 'zone of discretion' across boundaries becomes *fuzzy* and may/can generate role ambiguity and conflict. These boundary spanning role problems may be enhanced when an adjacent nodal *partnership* (e.g. a supplier/customer interface) develops and becomes an 'internal advocate'. Other aspects, not fully understood, or which cannot be explained in connection with networks, are usually lumped under the convenient, general (and academic) catch-all of *culture*. Of noteworthy comment is the conclusion of Farmer and Ploos van Amstel (1991:72) that convergent distribution is a field of activity which would repay far greater management attention than has been given to it traditionally. It is obvious that there is/are advantage(s) for the systems manager who has the greatest control over the inflowing materials (and resources).

As an illustration of a converging links and nodes military supply network used in the Gulf War which resulted in congestion and bottlenecking, Menarchik (1993:175)



(Adapted from: Harland, 1996) **Figure 5.1 The Four Levels of Logistics Systems**

informed us: ""The airlift funnel effect" slowed the mobility process. Cargo planes operated out of many stateside airfields but mainly used four en route airfields in Europe and four reception fields in the Gulf. As cargo airplanes flowed to the Gulf, they entered an ever narrowing funnel, resulting in airport congestion that clogged supply lines and slowed distribution."

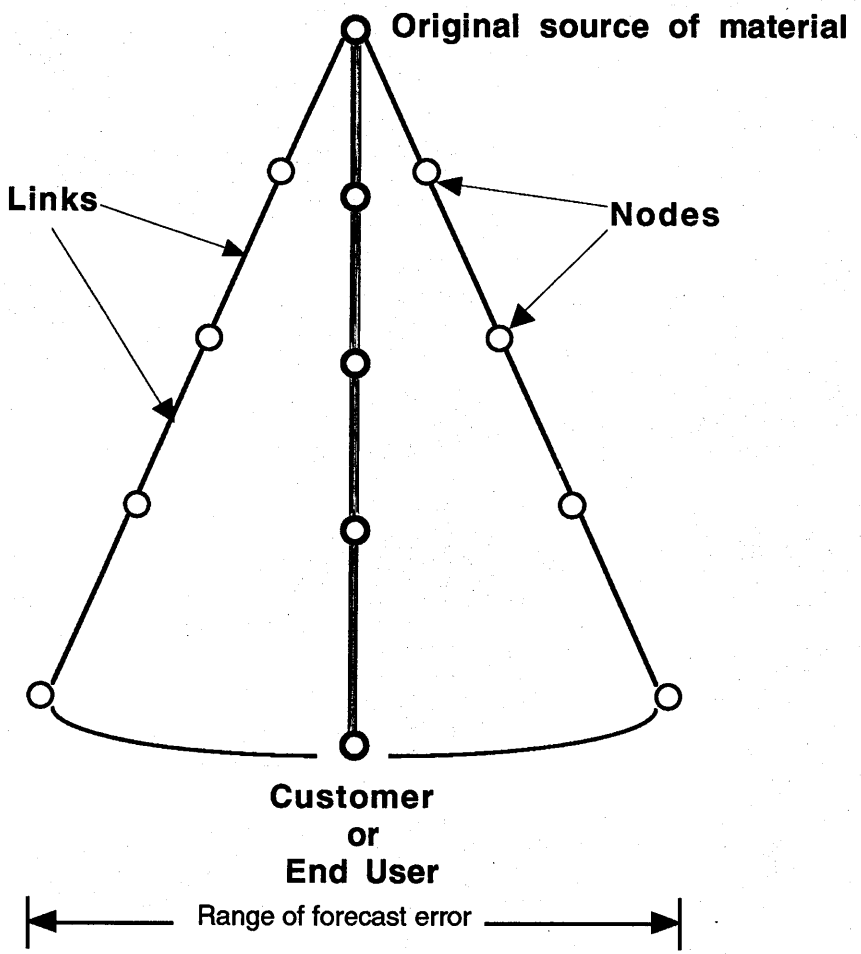
An engaging analogy is to consider the link/node arrangement as a 'bar chain' mechanism, where the bars represent the links and the couplings represent the nodes. If the bar chain is pivoted vertically from the original material supply node/coupling (i.e. the beginning) and, the flow of materials is continuous and steady, then the mechanism can be said to be in phase and swing in harmony like a pendulum. Also, the further the customer or end user is away from the original source of material, the latitude of the customer/end user node's swing distance represents the potential range of demand forecasting error, or as Wight (1974:157) phrased it: "Forecasting is like aiming a gun; the further away from the target one stands, the less accurate he is likely to be." Should a jolt, shock or some disturbance (like a promotion or accidental catastrophe in a supply chain) impact a part of the bar chain, the result would be a wild, erratic, out of phase swing at the point of the impact, with a tendency to 'whiplash' or 'snake' the rest of the bar chain. This disharmonious swing results in erratic supply flow; see Figure 5.2(a)/(b).

Lee, Padmanabhan and Whang (1997) referred to this phenomenon as the *Bullwhip Effect* and offered four causes for this: demand signal processing; the rationing game; order batching and; price variations. Levit (1994:69-70) described a similar phenomenon within a supply pipeline which he called the 'ripple factor'; he said this ripple factor could build-up constructively resulting in a cumulative effect which he likened to a *tsunami*[28].

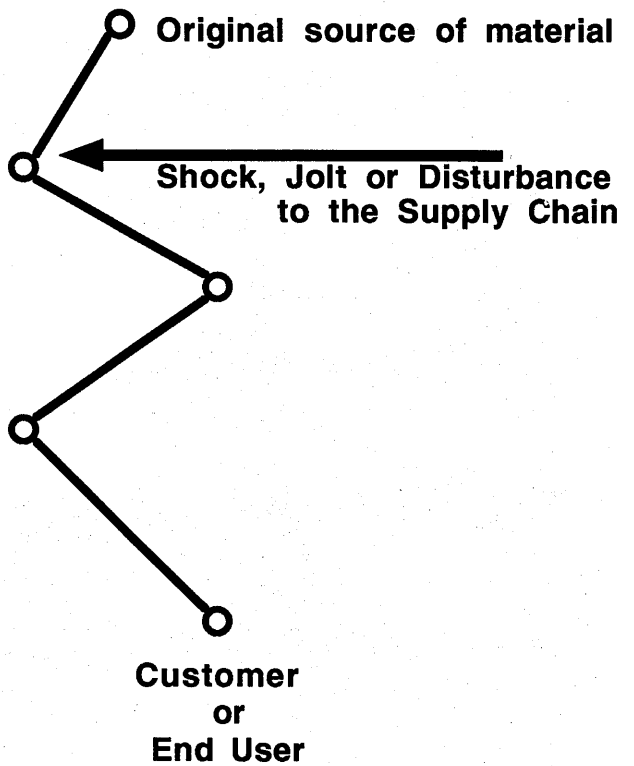
Interestingly, the node-link analysis approach is applicable in the mapping of material flow through a factory too, where the nodes are processing centres or individual machines. This leads to a postulation that supply and distribution systems are 'reverse fractals' of factory material flow. (Fractals[29] are geometrical entities characterised by basic patterns that are repeated at ever decreasing sizes. For example, trees describe an approximate fractal pattern, as the trunk divides into branches which further subdivide into smaller branches which ultimately subdivide into twigs; at each stage of division the pattern is a smaller version of the original.) If this 'reverse fractal' analogy is accepted, then the principles of factory material flow management, i.e. self similarity, can be applied to the larger scale of supply and distribution material flow management.

[28] Tsunami is a brief series of long, high undulations on the surface of the sea caused by an earthquake or similar underwater disturbance. These travel at great speed and often with sufficient force to inundate the land.

[29] Fractals were devised in 1967 by French mathematician Benoit Mandelbrot, during a study of the length of the coastline of Britain. They are relevant to any system involving self-similarity repeated on diminishing scales, such as in the study of chaos, fork lightening, or the movement of oil through porous rock and, logistics too.



(a) Harmonious swing - steady supply



(b) Disharmonious swing - erratic supply

Figure 5.2 Bar Chain Analogy of Supply Chain Nodes and Links

This vinculum between factory and logistics material flow is important because most of the material quick response management principles were developed for the factory (i.e. in manufacturing). It is these quick response principles that have the potential to be developed for application within the greater logistics system. Therefore, there is a need to look at some of the quick response methodologies that are being used in processing plants/factories. Before doing this a brief comment about inventory and, 'pull' versus 'push' systems would be helpful.

5.1.2 Inventory

The function of internal inventories in logistics systems is similar to their function elsewhere in that they act as a decoupling agent when inequality between supply and demand exists. Inequality between nodal flow rates, in the short term, is caused by the variability present in most nodal processes. In the case of some processes it is held that work times are not constant (unless mechanised) but can be described by a positively skewed distribution with a finite lower limit. Buzacott (1971:429) made the point that if, due to long term imbalance between stages a buffer stock is permanently full, it is serving no useful purpose. This implied that a measure of the effectiveness of buffer stocks is the magnitude of their size variation. Indeed, Stewart (1965:66) saw inventory management as a 'central activity' in his description of activity cogs in a distribution system.

Another factor to bear in mind with regard to inventory is the *rule of thumb* 'square root law'. This states that the inventory/stock amount/quantity necessary for a given cover is proportional to the square root of the number of stock holding locations (i.e. depots, warehouses, nodes), generally because of the safety stocks that would be held at every location (Sussams, 1992:76). The square root law also applies to variety and SKUs; that is inventory will increase approximately proportionally to the square root of the number of product variations, and the number of SKUs. Operators have to estimate the trade-off between central stock holding, extra transport costs and longer lead-times, versus dispersed stocks, higher inventory carrying costs but better response/service.

Inventory forms part of the current assets which contribute to the total assets base on a Balance Sheet. Total assets is a prime denominator used in the ratio analyses of a business. Therefore, if inventories were reduced, then the total assets amount is reduced, thus yielding a better return on assets (for a given profit), as well as improving the 'working capital' (the difference between current assets and current liabilities (i.e. net current assets)). Because of the age old 'capacity' versus 'stock (or inventory)' debate, this performance improvement can be utilised in another way: the savings from inventory reduction could be used to purchase more appropriate fixed assets, to enable capacity and flexibility improvements for better responses to demands. In this case the total asset base remains the same, but by altering the current asset to fixed asset ratio, better profits can be attained because of the responsiveness, thus yielding a better return on assets ratio.

It has become vogue to talk about 'inventory turns' and the strategies being adopted to improve them. The measure of inventory turns is not a new phenomenon as can be seen by the 1929 survey research of distribution problems of chain stores by Copeland (1931:302), when he reported: "The common figure for the rate of stock-turn was 10.2 times a year." These days, most commercial enterprises are pursuing a minimum inventory policy using many of the principles purported by Hall (1983), who pioneered and advocated the concept of 'zero inventories'.

5.1.3 Pull And Push Systems

Two basic disciplines govern the flow of materials: the pull method and the push method. With the push method, management (usually centrally) schedules the receipt of all raw materials and authorises the start of production (or other processes), all in advance of needs, that is it is supply driven. With the pull method, the final operator, assembler or processor checks the inventory level and the demand placed upon him/her and, when almost depleted, orders some more, that is it is demand driven (and decentralised). Table 5.2 compares an MRP II batch production push system with a JIT Kanban pull system.

5.2 Just-In-Time

By watching how supermarkets function, Ohno (1990) applied his observations of the supermarket by using shelf restocking as an analogy for his development of the Just-In-Time (JIT) inventory management method. He stated (Ohno, 1990:26): "From the supermarket we got the idea of viewing the earlier process in a production line as a kind of store." The supermarket analogy provided Ohno with an example of an enabling process from which he developed the Kanban[30] system for inventory flow management. JIT is a material flow management philosophy that seeks to eliminate three 'monads': waste, excess and unevenness (i.e. levelling the flow of material(s) by eliminating all causes of demand distortion, fluctuation or amplification by both demand and supply *smoothing*). Toyota, who claim to have an 'all out attack on wastes', list seven classic wastes:-

- overproduction - the most serious waste according to Taiichi Ohno (in Lu, 1986), overproduction is akin to excess;
- waste of defects - this follows the cost of quality discussions;
- waste of waiting - inventory or people being static or idle respectively;
- waste of transporting - can never be eliminated but, constantly seek to reduce it;
- waste of inappropriate processing - use of smaller and faster machines for flexibility;
- waste of unnecessary inventory - constantly seek to minimise the quantity;
- waste of unnecessary motion - elimination of physical motion to cut fatigue and wear.

[30] Kanban, meaning card or visible record in Japanese, refers to cards used to control the flow of production through a factory.

Comparison of Operations Push and Pull Systems Representing, Respectively, MRP II / Batch Operations and JIT (Kanban)

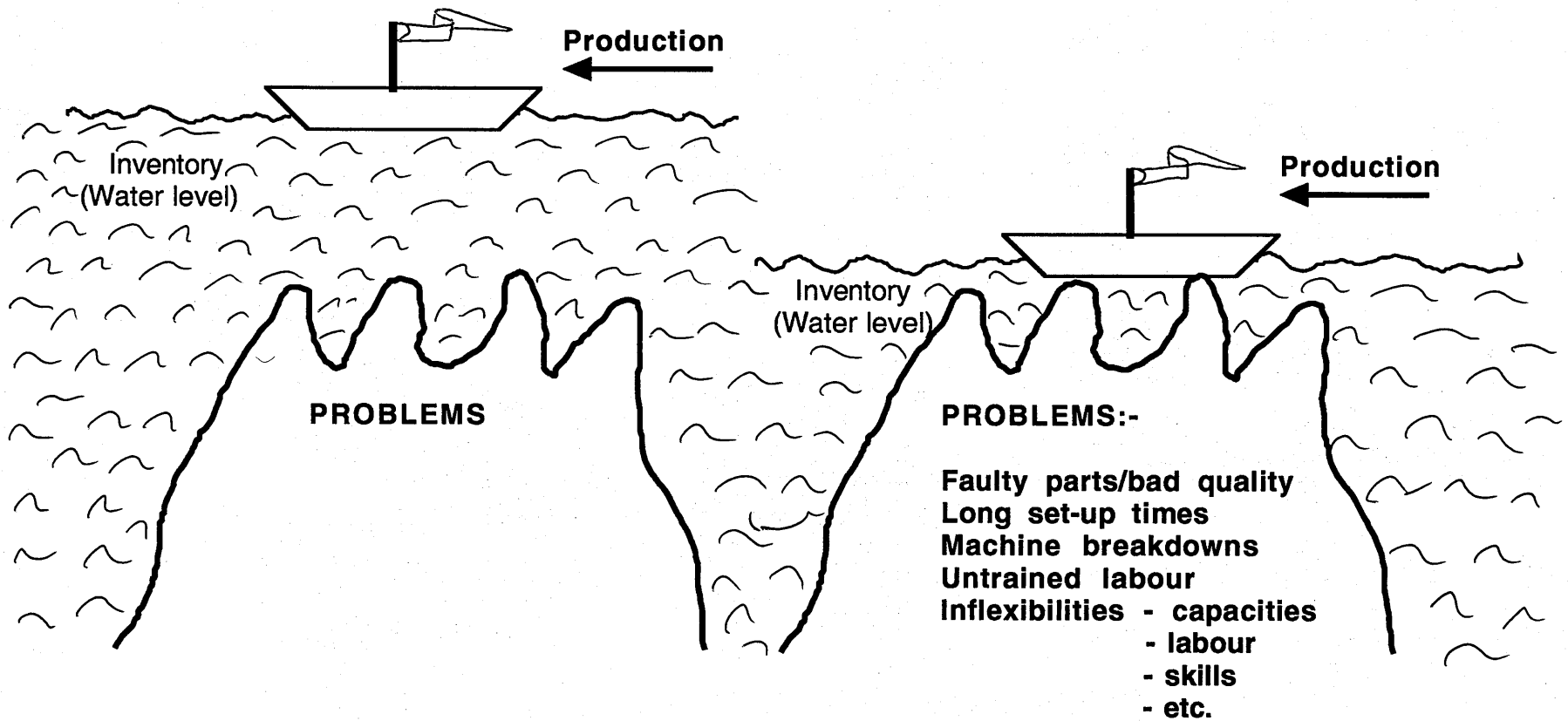
System Characteristics	Operating Push System (MRP II and Batch Production)	Operating Pull System (JIT (Kanban) Production)
General Approach	Balanced, non stop production to meet a predetermined schedule. Extensive computerisation to handle complex procedures. Task-oriented workers with specialised skills.	Simple, flexible production responds quickly to demand changes. Minimised record keeping and simplified methods. Thinking workers with many skills.
Machines	Specialised machines. A few large "super machines". Single-purpose tooling. Sophisticated material-handling devices to move large quantities of material. One operator per machine.	General-purpose machines. Many small machines. Flexible tooling and simple set-ups. Material handling limited by placing work centres near to one another. Multiple machine responses.
Materials	Multiple suppliers to avoid disruption of deliveries caused by single sourcing. Large, infrequent deliveries. Obtain stock from storage.	Limited number of suppliers with established close coordination with each other. Small, frequent deliveries. Obtain stock from production.
Production Practices	Fixed model production runs. Keep labour busy. Identify manufacturing defects. Performance measured by output and individual accomplishments. Extensive planning by the engineering department to correct problems before they occur. Quality control department monitors quality. Inspect quality in.	Mixed-model production runs. Keep material moving. Prevent manufacturing defects. Performance measures set to show individual quality and team productivity improvements. Joint problem solving by an engineering staff, and management to correct problems as they occur. Individual workers are responsible for quality. Build quality in.

Table 5.2 Comparison of MRP II Push System and JIT Pull System

JIT is a 'pull' (i.e. a demand driven) system, as Christopher (1992:153) wrote: "It is based upon the simple idea that wherever possible no activity should take place in a system until there is a demand for it. Thus no products should be made, no components ordered, until there is a downstream requirement." Another powerful feature about JIT is that it is a 'visual' technique; problems and impediments to flow are observable - not hidden or concealed - and problems can be picked-up by observation, i.e. things not in the correct place, or a build-up in inventory signifying there is a blockage/bottleneck to downstream flow. O'Grady (1988:14) posited four aspects to JIT: "attack fundamental problems; eliminate waste; strive for simplicity; and devise systems to identify problems".

The usual analogy to describe JIT is the 'water level' illustration (Christopher, 1992:159; Dear, 1988:13; O'Grady, 1988:36; Krajewski and Ritzman, 1993:705; Stevenson, 1993:696). Referring to Figure 5.3: treat the water level as inventory; the sailing boat (representing production) with sufficient draught floats on the surface totally unaware of the stalagmites beneath it; there is no impediment as the water level (i.e. the inventory) camouflages any potential danger (i.e. problems). Should the water level recede (i.e. reduce inventory) then the tips of some of the stalagmites become exposed (i.e. the problems are visible) and as some are just below the water line (i.e. potential danger), the boat has to be careful of insufficient draught and the possible holing of its hull. Therefore, removing inventory from the factory exposes the problems of: quality, long set-ups, machine breakdowns and general incapabilities. The principle being, that by fixing the problems (the impediments to work and material flow), large quantities of inventory are unnecessary and any further problems blocking flow become visible, thus prompting some corrective action. Dear (1988:19) used a 'scalloped riverbed' analogy showing some retained water and a reduced linear flow as the result. This demonstrated how some inventory becomes locked in the system reducing the real potential flow rate. Figure 5.4 is the schema used by Schonberger (1990:319) demonstrating quick, delay-free (JIT) response.

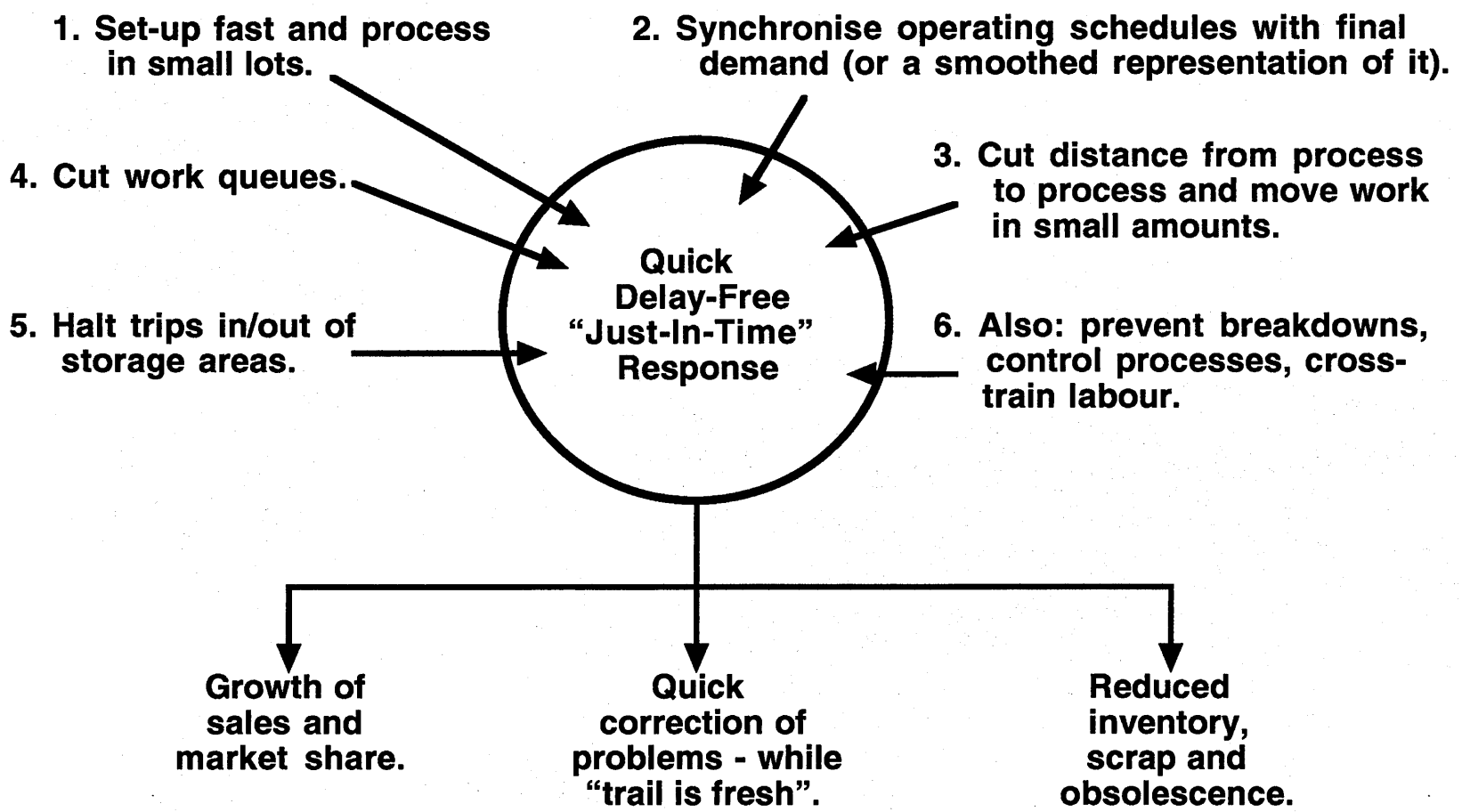
If reliant on inbound logistics, then to operate a JIT system properly requires good coordination and relationships with external suppliers. The need for smaller and more frequent deliveries prompts an imaginative approach to find a satisfactory solution to the possible under-utilisation of transport (i.e. less-than-truck loads (LTL)) and the desire to seek economies of scale. The ecological damage that ensues from exhaust emissions of road transport forces another consideration too. Instead of the large shipment of single products direct from each supplier, Hall (1986) offered three alternatives: (i) small shipments in mixed loads from groups of suppliers (a 'rim' system); (ii) by a pick-up route of a circuit of suppliers (many 'mini-rim' systems); and (iii) by use of consolidation points (probably a 'hub and spoke' and/or a 'cross-docking' operation). Localised vendor stocking provides another solution and a 'rim' system of delivery in preference to a 'spoke' system of delivery was advocated by O'Grady (1988:105-106), who suggested



Just-In-Time (JIT) Production exposes the problems that impede throughput, identifying where corrective effort should be focused.

JIT follows the philosophy of the elimination of three factors: WASTE; EXCESS; and UNEVENNESS.

Figure 5.3 Water Level Analogy of Just-In-Time (JIT) Production



(Source: Schonberger, 1990:319)

Figure 5.4 How Just-In-Time (JIT) Works

that within a group of suppliers, each supplier takes it in turn to pick-up and deliver the total multi-product consignment for each prescribed period. It should be noted that vendor stocking is not a solution that takes inventory out of the *whole* supply chain/network.

The above are examples of JIT confined to "JIT Supply" (a phrase still used in the popular press). The expectation is for JIT deliveries to minimise raw material stocks without translating this benefit further into: reduced batch sizes; managed material flow; and in-house waste reduction/minimisation in general. The American Production and Inventory Control Society (APICS) distinguishes the former approach by referring to it as "narrow JIT" as opposed to "broad JIT" which attempts to elicit the total benefits of JIT from both supply and manufacturing systems (Hall and Ippolito, 1992:1-3 to 1-10).

Over the long term the aim of JIT is to move steadily towards what Archier and Serieyx (1987:32-33) called "the five 'zeros'": zero paper; zero inventory; zero downtime; zero defects; and zero delay. These five zeros require wider interpretation: zero paper does not necessarily imply computers - but simplicity and visibility; zero inventory implies minimal levels of inventory and particularly minimal *idle inventory*; zero downtime applies to bottlenecks and also to flexibility; zero defect applies along the whole chain/network; and zero delay applies to design time, manufacturing time and, to distribution time.

In truth, JIT was probably first practiced by the construction/building industry in urban projects/areas, where space and accessibility were very limited. The erection of 'sky-scraper buildings' in any city being good examples, as Lawrence (1987:18) commented: "In modern times JIT techniques were developed in the US but adopted in industry by the Japanese. JIT methods were notably used in the building of the Empire State Building, where limited space in Manhattan meant deliveries had to be made on demand in small quantities." Bear in mind that the Empire State Building was built in 1930-1931. Certainly the limited, or lack of space in Japan was a cue/prompt for JIT.

5.3 Optimised Production Technology (OPT)

Optimised Production Technology (OPT) is three proprietary software scheduling systems based upon the theory of constraints, involving mathematical programming, networking and simulation. The emphasis is on identifying 'bottlenecks' and, if they cannot be improved, to optimise their use. Hence, OPT begins its scheduling procedure with the bottleneck operations and attempts to maximise their output. In essence, OPT is a finite loading procedure. For a comparison of the OPT philosophy with conventional rules see Table 5.3. Taken as a whole, the OPT philosophy changes some of the conventional rules of manufacturing and the OPT rules should be appreciated in order to understand the *derived* schedules. One of the OPT rules states: 'the transfer batch may

Conventional Rules	OPT (Global) Rules
Motto: The only way to reach a global optimum is by ensuring local optima.	**Motto: The sum of the local optima is not equal to the global optimum.**
• Balance capacity, then try to maintain flow.	• Balance flow not capacity.
• Level of utilisation of any worker is determined by its own potential.	• The level of utilisation of a non-bottleneck is not determined by its own potential but by some other constraint in the system.
• Utilisation and activation of workers are the same.	• Utilisation and activation of a resource are not synonymous.
• An hour lost at a bottleneck is just an hour lost at that resource.	• An hour lost at a bottleneck is an hour lost for the total system.
• An hour saved at a non-bottleneck is an hour saved at that resource.	• An hour saved at a non-bottleneck is just a mirage.
• Bottlenecks temporarily limit throughput but have little impact on inventories.	• Bottlenecks govern both throughput and inventories.
• Splitting and overlapping of batches should be discouraged.	• The transfer batch may not and many times should not be equal to the process batch.
• The process batch should be constant both in time and along its route.	• The process batch should be variable not fixed.
• Schedules should be determined by sequentially:- - Predetermining the batch size; - Calculating lead time; - Assigning priorities, setting schedules according to lead time. - Adjusting the schedules according to apparent capacity constraints by repeating the above 3 steps.	• Schedules should be established by looking at all of the constraints **simultaneously** (i.e. in parallel). Lead times are the result of a schedule and cannot be predetermined.

(Adapted from: Goldratt and Fox, 1986:178-179)

Table 5.3 Comparison of Conventional Manufacturing Rules Versus OPT (Global) Philosophy Rules

not and many times should not be equal to the process batch'. Compare this with one of Alexander the Great's strategies which was to divide his large army into smaller units so that their diminished requirements could be more easily provided during their advance through the countryside as well as increase their manoeuvrability (Engels, 1978:36, 61, 72, 120). The British Army decided to use these same tactics in South Africa during the 1899-1902 Boer War. In these cases, the process batch was the whole army; the transfer batches were the smaller units; and the process was foraging or living off the land and/or purveying smaller loads. This implied that Alexander the Great and the British Army were employing OPT principles and, the concept of parallel processing in earlier times.

The three OPT types of production homologies are known as the letters 'V', 'A' and 'T', see Figure 5.5. The 'V' configuration is divergent production, where one or very few inputs are used but the resulting outputs are numerous. The 'A' configuration is convergent production, where many inputs are used but the resultant output is one entity (for instance an average car consists of circa 5 500 parts if every nut, washer and bolt is counted). The 'T' configuration commences with similar inputs and similar operations initially and then continues with subsequent added inputs and possibly different downstream processes. The 'T' configuration employs the 'postponement' concept; Mather (1988:93-94) described this as the product taking on its unique identity at the last step of the operations. Whilst OPT has specific proprietary software packages - one each for the three 'V', 'A' and 'T' configurations - it is possible, however, to find other *alphabet letters* that describe different production material flow patterns; for instance Slack et al (1995:566-567) offered a conceptual configuration of 'X'. Also, the author was employed by a wire and cable manufacturer where an 'H' configuration was very descriptive of the production material flow.

5.3.1 Postponement

The principles of postponement and speculation in a distribution channel were enunciated by Bucklin (1965). An evaluation of these principles was made by Wills et al (1972:21-22): "The principle of postponement suggests that efficient marketing channels will refrain from differentiation until the latest possible time and that changes in inventory location will likewise be postponed as long as possible. The actual postponement, of course, reduces risk by shifting it elsewhere. But risk cannot be eliminated merely by shifting it within the channel. Its obverse, the principle of speculation, posits that the movement of goods to forward inventories should be made at the earliest possible movement in the flow of exchange to reduce overall channel costs. The principle explains economies of scale in manufacture and reduces the disproportionately large costs of repetitive orders, their sorting and transportation. Finally, of course, by shifting risk to groupings of institutions which are better informed about their own next levels, it can reduce uncertainty. These two principles act as limits one on the other."

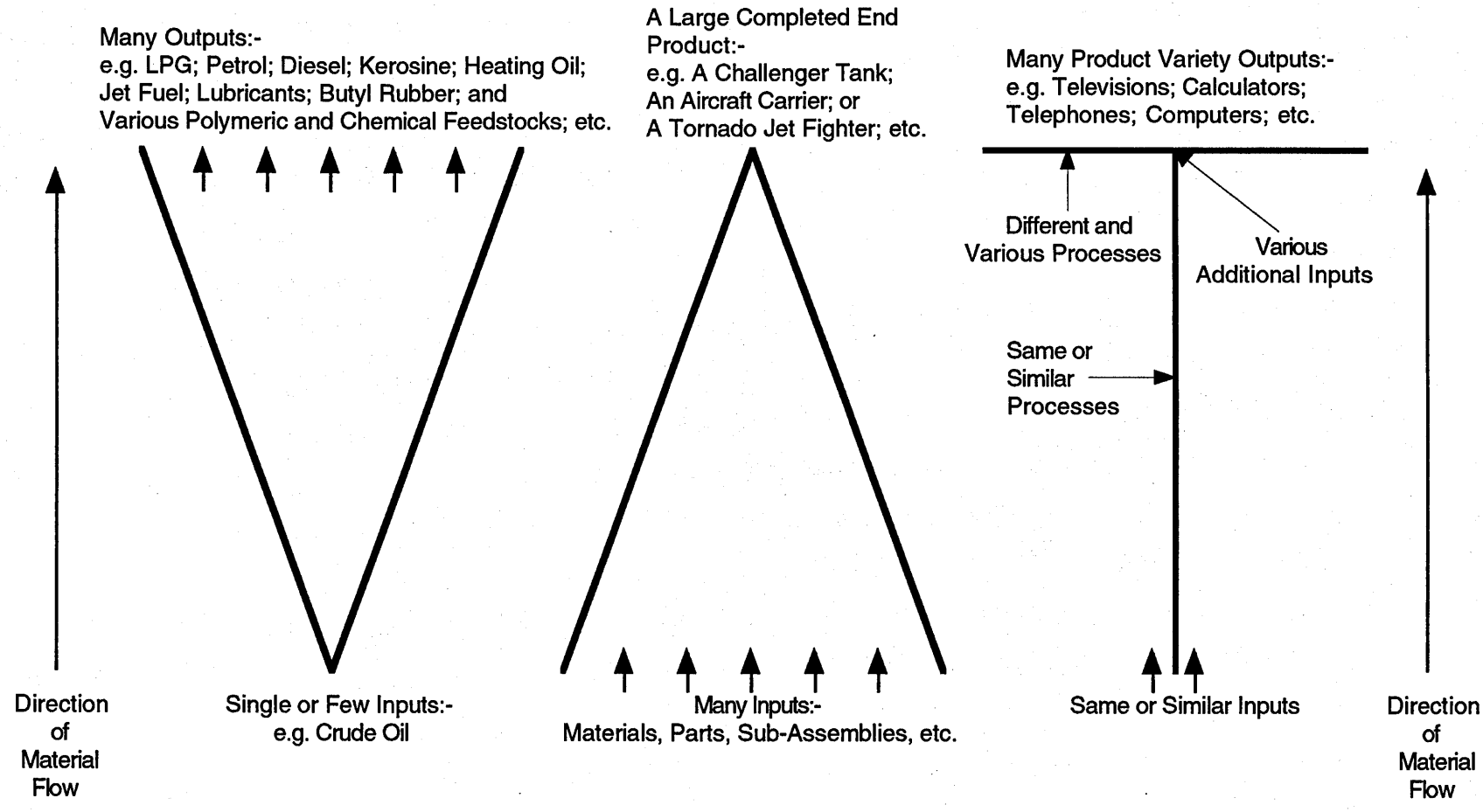


Figure 5.5 The Three Configuration Models of OPT: 'V', 'A' and 'T'

The puissance of the postponement concept was indicated by Heskett (1977:87-88) whereby, upstream from the postponement point standardisation of parts/components, inventory, processes and resources allows economies of scale, whereas downstream from the postponement point differentiation and variety can be offered to customers. This concept has been termed by some reporters/managers/academics as 'deferred differentiation'; another term used by Sharman (1984:75) is the 'order penetration' point. A spectrum of approaches involving different degrees of postponement from 'speculation' (i.e. make to stock) at one end, to 'postponement' (i.e. make to order) at the other end, was postulated by Shapiro (1984:122). Shapiro (1984:123) also offered this 'postponement spectrum' against 'breadth of product line' (i.e. from a narrow line to a broad line (including services and other benefits like 'one stop shopping', etc.)) on a 2 x 2 matrix; his thesis was that, all too often, inadequate attention was paid to how the interaction of the two spectra is crucial to the effectiveness of a logistics system.

So, postponement opportunities exist within logistics or distribution systems, as Christopher (1994:20) informed: "A further trend that is visible in distribution is the search for *postponement* opportunities. The principle of postponement is that the final configuration or form of the product should be delayed until the last possible moment. In this way maximum flexibility is maintained, but inventory minimised. The distribution function takes on a wider role as the provider of the final added value." There are two principal types of postponement as La Londe and Mason (1993:43-44) explained; they are: geographic postponement (i.e. where inventory or products are located, perhaps uni-centrically or proximity placing); and value-added postponement by 'form' (i.e. bundled manufacturing), deferred assembly or deferred packaging.

Examples where mass customisation and rapid delivery via postponement have been achieved at Hewlett-Packard are cited by Feitzinger and Lee (1997). Taking a holistic approach they also offered three organisational-design principles for effective mass customisation by postponement in the following comments (Feitzinger and Lee, 1997:116-117): "Instead of taking a piecemeal approach, companies must rethink and integrate the designs of their products, the processes used to make and deliver those products, and the configuration of the entire supply network. By adopting such a comprehensive approach, companies can operate at maximum efficiency and quickly meet customers' orders with a minimum of inventory."

"Three organizational-design principles together form the basic building blocks of an effective mass-customization program:

- A product should be designed so it consists of independent modules that can be assembled into different forms of the product easily and inexpensively.
- Manufacturing processes should be designed so that they, too, consist of independent modules that can be moved or rearranged easily to support different distribution-network designs.
- The supply network - the positioning of inventory and the location, number, and

structure of manufacturing and distribution facilities - should be designed to provide two capabilities. First, it must be able to supply the basic product to the facilities performing the customization in a cost-effective manner. Second, it must have the flexibility and the responsiveness to take individual customers' orders and deliver the finished, customized goods quickly."

Interestingly, the postponement notion is used in the military. In the case where missiles, like those using nuclear or biological/chemical war-heads, are too dangerous to handle/transport in the full assembled configuration, they are handled and transported in separate parts and are then assembled in the field just prior to being fired/used/employed. A suitable name for this could be 'safety postponement' for obvious reasons and, from the viewpoint that an enemy would have to secure/obtain all of the component parts if he wished to use such weapons against their original owners. Another example is the 'augmenting 'C'-ring charges' that are added to the tail of mortars - just prior to firing - according to the target range/reach requirement(s). Geographical postponement is used by the military as well, particularly if they anticipate that placing their inventory too close to the action puts it in danger of being destroyed, or indeed purloined, by the enemy. Pre-positioning (or 'dumping') ammunition and/or war/battle materials is a form of geographical postponement. Modularised components and units are used widely within the military for quick/rapid repairs and exchanges at the first-line level, thus minimising the time taken for equipment/kit to be returned to operational availability; in fact modularisation is one of the main Integrated Logistics Support (ILS) principles cited earlier for the reduction of turnaround time, i.e. minimising the time to repair. The need here is for replacement modules to be readily available, i.e. in-stock, carried as a spare (on-board) by the military unit itself, and/or *close* to hand via some other means (e.g. 'hot' or 'cold' redundancy).

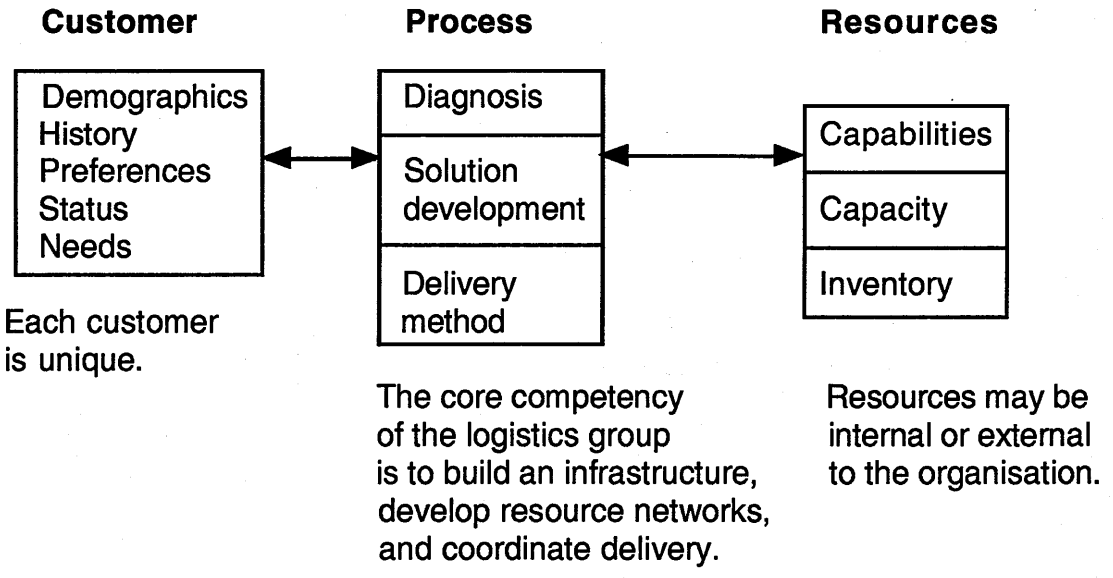
The next chapter shows how many of the above theories/principles and concepts work together in a system (enabled by computing technologies) where a description is given of the current knowledge and status on 'quick response' (QR) or 'efficient consumer response' (ECR) logistics.

6. QUICK/RAPID (EFFICIENT CONSUMER) RESPONSE LOGISTICS

"A company with the best distribution system and best service will win all the marbles - because you can't keep the advantages in other areas for too long."
Lee Iacocca (1924-) - former Chairman of Chrysler Corporation

6.1 Responsive Organisation

Davis and Gibson (1993:419) have offered an evolved view model of a responsive organisation; the model, as a logistics framework, consists of a triple centred arrangement of 'customer', 'process' and 'resources'. The model is shown below in Figure 6.1. Davis and Gibson (1993:426-430) continued by describing the interface between the customer and the process as 'Front-Room Management' (i.e. relationship with the customer) and the interface between the process and the resources as 'Back-Room Management' (i.e. relationship with the resources).



(Adapted from: Davis and Gibson, 1993:419)

Figure 6.1 Evolving View of a Responsive Organisation

Front-Room Management consists of four cogent tasks: Relationship Management (i.e. between the customer and the organisation); Interaction Management (i.e. again, between the customer and the organisation); Diagnosis of Need (i.e. the diagnosis process); and Customer Service. Back-Room Management consists of a further four cogent tasks: Protocol Management (i.e. customised responses); Task Management (i.e. total co-ordination); Capacity Management; and Interface Management (i.e. the removal of non-value adding activities and the minimisation of the cost of co-ordinating

activities). With these concepts at hand an insight into Quick Response Logistics (QRL) can be embarked upon.

6.2 Quick Response Logistics (QRL)

Quick Response Logistics (QRL), or Efficient Consumer Response (ECR) as it is known in the grocery trade, is a methodology which involves the sharing of 'up to the minute information' between companies throughout the supply chain. In order to be effective, QRL embraces the constant monitoring of product consumption and then quickly and regularly replaces the items that are consumed/sold by the use of: barcoded tickets; container labels; and exchanging electronic documents.

To a manufacturer, QRL means monitoring what merchandise is being sold by the retailer. This information helps the manufacturer order the appropriate levels of raw materials in order to fulfil requirements as they are needed. The data generated by Electronic Point of Sale (EPoS) terminals is the ideal foundation from which to forecast future or further demand. In essence QRL is the timely, accurate, paperless two-way information flow resulting in smooth, continual product flow matched to actual consumption; a musical analogy implying the seamless effect would be 'legato style'. The ideal response is that which is directly proportional to the 'disturbance', the disturbance being the demand pattern.

QRL is built on a new kind of trust-based relationship between companies and on redesigned business processes throughout the entire supply chain. These relationships also rely on just-in-time (JIT) delivery concepts coupled with flexible manufacturing in small lots to synchronise the flow of goods, thus matching retail customer demand. Agostino (1993) summed it up with: "Quick Response is primarily about enterprise-to-enterprise co-operation. Technology is merely the enabler." The benefits of such alliances and co-operation are discussed and explored by Bowersox (1990).

QRL was developed in the US during the mid 1980s in the fashion apparel sector (Walker, 1994:207) and probably the first publication reporting and illustrating the practical benefits of QRL was Frazier (1986), and probably the first book on QRL was published by Hunter (1990). What follows now describes the thought-processes behind its conception, design and *modus operandi.*

6.2.1 Quick Response Logistics Conception

In the US, the primary competitive response of the textile and apparel sector during the 1970s and early 1980s was to seek legislative protection from imports while investing heavily in modern equipment. By the mid 1980s the textile and apparel industry was one of the most protected in the US through an import quota system and

the textile industry had the highest rate of growth of any US manufacturing industry. Despite these successes, import penetration in the apparel sector continued to increase. Several industry leaders realised that protectionist measures by themselves would not be sufficient to preserve a strong US apparel manufacturing industry and that other initiatives were required.

In 1984 these industry leaders formed the "Crafted With Pride in USA Council". This body was funded by contributions from member companies in the apparel, textile and fibre industries. The Council's mission was to promote the benefits of US-made textiles and apparel to the consumer.

The Council committed part of its budget to research ways of improving the long term competitiveness of the US textile and apparel industries. A survey for a supply chain analysis was conducted in 1985 which revealed that although individual parts of the system were efficient, the overall efficiency of the system was very low; the age old problem of sub-optimisation being sought thus sacrificing total optimisation. Specifically seeking to minimise costs independently of each other, the fibre, textile, apparel and retail companies were inadvertently pursuing practices that added significant costs to the overall supply chain.

"The apparel supply chain, from raw material to consumer purchase, was 66 weeks. Of this, 11 weeks was in-plant time (fiber, textile and apparel), 40 weeks was in warehouses or transit (fiber, textile, apparel and retail), and 15 weeks was in-store. This long supply chain was both expensive to finance and, even more significantly, resulted in major losses as either too much or too little product was produced and distributed based on inaccurate forecasts of future demand." (Kurt Salmon Associates Inc., 1993:17)

The outcome of this research led to the development of the 'Quick Response Strategy' for general merchandise retailers and suppliers. QRL is a partnership strategy in which retailer and supplier work together to respond more quickly to consumer needs by sharing information from EPoS data to jointly forecast future demand for replenishable items and to continually monitor trends to detect and discover new opportunities for new items/products. Operationally, both parties use Electronic Data Interchange (EDI) to speed the flow of information thus enabling activities to be jointly reorganised or re-engineered to minimise lead times and costs.

With respect to the detection or discovery of opportunities for new items/products, companies engage in the prototyping of new products and 'fast-track' product development and testing.

6.2.2 Quick Response Logistics Model

Irastorza (1993:12) wrote: "QR can be viewed in five stages of sophistication though few have attained its highest reaches." The stages referred to by Irastorza (1993) relate to increasing degrees of partnership commitment and recognition of the benefits of supply chain co-operation. As companies progress towards the later stages they strive to attract and construct mutually beneficial alliances and partnerships for the long term. Today, alliances have been, and are, being forged in a multitude of well-documented combinations.

Kurt Salmon Associates Inc. (1993) illustrated a more complex example of a four company consortium in the women's ready-to-wear apparel business:-

- DuPont Co. - which manufactures the fibre
- Milliken & Co. - which converts the fibre to fabric
- Leslie Fay - which produces women's garments

and
- Dillard Department Stores - which sells them.

The whole stock replenishment cycle is handled efficiently and cheaply - automated where possible - and the development of new products is coordinated between the consortium. This example is cited as it represents a commitment by each company to the integration and consideration of the whole supply chain. For example the Boston Consulting Group[31] cited Milliken & Co. as having "discovered" what problems its customers (i.e. Leslie Fay and Dillard Department Stores) were plagued by, i.e. that of having too many items left at the end of the season. Between them, they created a new ordering system where the retailers could place an order at the start of the season, then make "mid-flight course corrections" in a series of separate reorder stages. Milliken & Co. had to change its entire internal delivery system to ensure that it would be able to meet this new development. These efforts yielded three outcomes: a world class internal delivery system for Milliken & Co; more orders from their customers who were grateful for the empowerment (i.e. client/customer empowerment) and; a more competitive apparel industry. Although they have not progressed to Stage 5 of the model, they have demonstrated that alliances and cooperation can be achieved.

The five development stages of the QRL model are shown in Table 6.1 and a description of each Stage is now explained. The stages as a whole (or as a system) will be referred to as the QRL model.

6.2.2.1 Stage 1 - QRL Model

Stage 1 is concerned with the more technical aspects of QRL and because of this

[31] See "Discovering how to maximise customer share", *Marketing Business*, September 1993, Issue 23, pp 12-16

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Barcoding Universal Product Code (UPC) European Article Number (EAN) Unique Container Code (UCC)	Fixed-Cycle Auto-Replenishment	Replenishment Partnerships	Joint Product Development	Retail Space Management
Electronic Data Interchange (EDI)	Monday's orders shipped by Friday	Shared forecast data	Fast-track product development and testing	Supplier-assisted display and sales

Table 6.1 The Five Developmental Stages of the Quick Response Logistics Model

many retailers see QRL as a technology-based initiative rather than as an organisational one. Although Quick Response is primarily concerned with forging better customer-supplier alliances to increase responsiveness to the consumer, it must be remembered that achieving this warrants the need for certain technologies to allow speedy manipulation, communication, storage and retrieval of data.

Stage 1 typically includes such technologies as follows:-

- Universal Product Code (UPC), or European Article Number (EAN), Unique Container Code (UCC) - 128 in Europe
- Point of Sale (PoS)
- Electronic Data Interchange (EDI)
- Shipping Container Marking (SCM)
- On-Line UPC Catalogue

Whilst the greatest benefits of Quick Response Logistics are realised when the technologies are driven by a commitment to the strategic concepts, it is worthwhile analysing the contribution of each of these technologies to understand their respective contributions to customer service and therefore higher profits/margins.

This list is not exhaustive; nor is it meant to imply that without *all* of the technologies, progression to the later stages cannot be achieved. It is to be used simply as a guide to some of the technologies involved and their contribution to the QRL model.

The use of Universal Product Code (UPC) and Point of Sale (PoS) data collected (or captured) via electronic/laser scanners allows companies to:-

- Virtually eliminate stock counts
- Reduce promotional re-ticketing
- Reduce shrinkage caused by pricing and keyboard errors (use of electronic scanners)
- Capture sales data at the item level (using electronic/laser barcode scanners)
- Improve customer checkout productivity (using electronic/laser barcode scanners)
- Improve sales service (and returns) and staff friendliness

The PoS information is particularly important in that it allows retailers to retain product-specific information about consumer spending patterns, such as styles, colours, sizes, pack sizes and even times and methods of purchase. As Lewis (1991:18) reported by quoting David Targett (of Bath University's School of Management): "Quick response is all about making sure that what the customer wants is there at the right time. That means quick links between sales points, a company's headquarters, its suppliers and its distribution system". To illustrate the process further and to show how the data can be utilised in a beneficial way, Lewis (1991:19), again quoting Targett, reported: "The 7-Eleven company in Japan changes its store layout three times a day because its epos systems have analysed when people are buying different types of products". The umbrella term for this type of analysis is 'customer profiling'. Further individual data analyses can be conducted called 'consumer finger-printing', which is something that Sainsbury, Tesco, Safeway, Boots and others have done by issuing personalised loyalty cards to their consumers/customers and 'swiping' them after every transaction, thus capturing the individuals' purchasing preferences and behaviours (i.e. times of shopping, etc.). Many supermarkets are also practicing electronic banking of cash by offering their customers cash and debiting the *Switch* or other non-interest charging cards using Electronic Funds Transfer at Point of Sale (EFTPoS). Other examples of retail improvements like: store attributes; store environment; and convenient store layout, as a result of QRL have been reported by Ko and Kincade (1997:92-96).

Electronic Data Interchange (EDI) allows companies to:-

- Reduce non-value added time to shorten lead times
- Reduce clerical processing associated with buying and administrative functions
- Reduce the need for data entry
- Reduce the level of exception processing

Shipping Container Marking (SCM), used in conjunction with an Advanced Shipment Notice (ASN), provides significant savings by:-

- Improving merchandise throughput in the Distribution Centre
- Reducing the level of shipment exceptions

An on-line catalogue provides a single source for UPC product information

communication. It is a centralised database which is used by manufacturers to store their UPC information so that retailers can access it.

In the US companies use the retail industry standard, which creates the advantage of providing a common language for UPC exchange. This type of system would not be feasible in the UK at present as the retailers all use different UPC codes rather than one common industry-wide standard. The best way at present to alleviate the problems of UPC transfer is with 'dictionary' databases resident at each supplier to convert retailers' codes into associated in-house ones.

6.2.2.2 Stage 2 - QRL Model

The second level of sophistication relates to the automatic replenishment of sold goods. Here, the retailer and supplier commit themselves to having known lead times for replenishment which are shortened as much as possible. It must be stressed that the method used to shorten lead times is NOT to increase buffer stock, but to use flexible manufacturing techniques to provide quick/fast/rapid response.

To further highlight the importance of known/consistent lead times, from their research about logistics service quality Stock and Lambert (1993:63) reported: "'Consistent lead times' was uniformly rated as very important in every industry. The ability of firms to be able to maintain a consistent order cycle for products ordered by customers is extremely important to those companies which operate just-in-time (JIT) or 'quick response' programmes. Variability in the order cycle causes significant problems to firms operating with minimal levels of inventory resulting from JIT operations. With little or no safety or buffer stocks, late receipt of orders could cause product stock-outs or production slowdowns/shutdowns."

"The 'ability to expedite emergency orders in a fast, responsive manner' is also rated as important in every industry. When problems occur, and customers require products 'in a hurry', it is vital that vendors be able to provide rush service. Even if vendors are able to eliminate most, or all, of the factors that could cause delays or mis-shipments, some unavoidable problems occur periodically. When those occur, vendors must be able to provide high levels of customer service relative to emergency shipments."

"Other attributes such as providing advance notice of shipping delays, action on complaints (responding effectively to customer complaints), information on projected shipping date for orders, accuracy of vendor in forecasting and committing to shipping date, and length of promised lead times, were also rated as important in each industry."

"The five attributes which were not included in the surveys of each industry, but which were rated as being important, included 'information on projected delivery date is provided when order is placed', 'information on inventory availability is provided when order is placed', 'ability of manufacturer to meet promised delivery date', 'damage-free shipments', and 'length of promised lead times for emergency orders'. When these attributes were evaluated by customers, they were often considered to be some of the

most important logistics service attributes."

A further development is that the retailer can use automatic replenishment techniques where purchase orders are automatically generated and forwarded to suppliers. Known lead times are fed to the system, which can calculate when to place an order, considering on-hand inventory levels. This is known as Computer Assisted Ordering (CAO).

Automatic replenishment systems constantly monitor inventory levels and reduce the manpower traditionally used in checking inventories. These systems support smaller lot sizes and more frequent deliveries, which improve in-stock position and reduce on-hand inventory.

During an automatic replenishment pilot, a major department store chain reduced inventory levels by 21% while reducing stock-outs by 96% and increasing overall service levels to over 99%.[32]

Many UK companies will claim to be operating in this type of environment at present as they can supply garments to retailers within 3-4 days typically. However, they can achieve these service levels by supplying from stock which inevitably increases costs and decreases margins.

6.2.2.3 Stage 3 - QRL Model

The third stage is concerned with the trading partners forging closer alliances through mutual inspection of their supply chain and identifying areas of improvement. The scope of inspection is limited to the replenishment of existing products and concerns areas such as cost reduction, service improvements and time compression.

One of the most immediate methods of mutually reducing cost is to reduce the amounts of buffer and safety stock in the supply chain. This type of inventory is only held to cope with unanticipated demand - therefore the easiest way to reduce this inventory is to have better information regarding actual demand. One of the best methods to achieve this is through forecasting by the use of mathematical algorithms which are applied to historical sales data to determine future demand.

For instance, as Guedes, Saw and Waller (1993:117) identified: "Recent interest in 'quick response' and 'just-in-time' has raised the need for complete inventory modelling. The objective may be to consider the following two issues:
- *setting stock levels*, ie working stock and safety stock levels to meet the customer service requirements taking into consideration variability of demand, replenishment quantities, time and cost, and the costs of inventory.

[32] Andersen Consulting, "Quick Response", Commissioned by the Voluntary Inter-industry Communications Committee (VICS)

- *stock location in the supply chain*, ie where to locate products stock in the supply chain structure, eg fast moving products close to demand and slow moving products centrally located."

"The most commonly used technique to model inventory is dynamic simulation. Both 'event-driven' simulation and 'systems dynamics' based simulation have been used extensively in this area. ... Average working stock levels can be derived from the inventory reviewing system and safety stock from measures of inventory availability and demand variability. Stock location can also be treated in a simplified way."

In the traditional operating environment, forecasting is done by both trading partners independently of each other using different forecasting models. Inevitably, different future demand is predicted by each partner, resulting in different order requirements, thus causing confusion and increasing costs in the chain.

In the QRL environment, both partners use the same data in conjunction with each other to anticipate future demand. The aim and procedure of such an arrangement have been described by Christopher (1994:20) thus: "... to reduce our dependence upon the forecast by improved information on demand and by creating systems capable of more rapid response to that demand. ... Quick response logistics has become the aim for many organizations, enabling them to achieve the twin strategic goals of cost reduction and service enhancement. In essence, the idea of quick response is based upon a replenishment-driven model of demand management. In other words, as items are consumed or purchased, this information is transmitted to the supplier and this immediately triggers a response. Often high speed, smaller consignment quantity deliveries will be made; the trade-off being that any high transport costs will be more than covered by reduced inventory in the pipeline and at either end of it, yet with improved service in terms of responsiveness. Clearly information technology has been a major enabling factor in quick response logistics, linking the point of sale or consumption with the point of supply."

This mutual sharing of data (in particular visibility of the scanned data to all the necessary players in the supply chain) is a radical departure from current retailer-supplier relationships where an adversarial environment tends to be the norm. Some retailers fear that communicating all this information to suppliers might lead to a loss in their competitive edge. The experience of many companies suggests that the opposite is true. These steps can make a substantial difference to the way suppliers operate and reducing a supplier's costs gives the retailer an opportunity to improve margins. Again, a trust-based relationship is enhanced and the partners work in unison, rather than as adversaries, as Christopher (1994:20-21) summed it up: "Reliability, Responsiveness and Relationships."

Improved data accuracy, improved tools to analyse seasonal and daily variations in

demand and the assessment of the impact of promotions are the three key steps to producing the reliable forecasts at the store and item level which drive the whole replenishment system. The sharing of demand forecasts with suppliers enables those suppliers to reduce the high level of safety stock they carry.

6.2.2.4 Stage 4 - QRL Model

"QR takes its name from the goal of responding more effectively and more quickly to consumers' changing fashion tastes. As the market for general merchandise products such as apparel, footwear, home fashions, cosmetics etc. becomes more fragmented and more volatile, the traditional sequential product development process becomes less and less effective. This traditional process is organised functionally with each function doing its task before handing over to the next function. While this minimises cost, it also creates a long and inflexible process which results in high losses as excess product is marked down to be sold at or below full cost [hence reducing margins][33]. These markdowns occur on products produced by the vendor which the retailer didn't buy and on products bought by the retailer which the consumer didn't buy. Both problems are caused by inaccuracies in forecasting what the customer will buy many months in the future." (Kurt Salmon Associates Inc., 1993:89.) This process of fast response to changing tastes and desires is described by Sanchez (1996:133) as: "Electronic links now increasingly connect real-time sales of products to distribution and manufacturing processes, creating a kind of 'electronic kanban' system for driving upstream logistics and production scheduling with real-time data, ... Electronic kanban systems are also now being extended to directly drive product creation processes in real time. ... Real-time sales data become "electronic kanban" driving product creation, manufacturing and distribution."

QRL companies have made major changes to their product development processes. Their new method is based on continuously monitoring PoS activity to detect trends and constantly testing new product concepts in a limited number of stores. This procedure is shown in Table 6.2 below (from Kurt Salmon Associates Inc., 1993:90). This approach has been adopted by leading US companies e.g. Wal-Mart and Procter & Gamble (Kurt Salmon Associate Inc., 1993). Due to the importance of speed, these companies have created cross-functional development teams using members from each partner company and containing all the functional skills required e.g. design, development, costing and purchasing. Working concurrently on a new concept the team members can cut weeks out of the development cycle. Companies benefit from significant reductions in product development and introduction costs, the key benefits include:-

- reducing the failure rate of products brought to full consumer introduction;
- optimising the marketing strategy during the test period in a realistic market environment; and
- identifying new opportunities for profitable production through closer customer

[33] Square bracketed comment added by the author.

New Product Development Benchmark			
Identify potential opportunity	Create test quantity of product	Monitor PoS in stores	Order larger quantities for more stores
	Days: 20	20	30 to 60
Total = 70 to 100 days			

Table 6.2 New Product Development Under Quick Response

involvement.

6.2.2.5 Stage 5 - QRL Model

The fifth stage of the QRL model relates to a partnership scenario where the supplier is handed full responsibility of the supply chain right up to the point of purchase by the end customer. A version of this is called Vendor Managed Continuous Replenishment (VMCR). Here the supplier is given an allocation of shelf space by the retailer and the supplier is charged with providing full stock replenishment, in-store promotion and staff product-training where necessary.

A comparison can be drawn here with the cosmetics sections of department stores, where the counter can be considered as "a store within a store". The staff have full product knowledge and are trained and supported by the suppliers rather than the retailer. It is in both trading partners interests that shelves are replenished efficiently as both parties are receiving profits from product sales.

However, this is not a problem for the suppliers who have reached this stage of the QRL model. By passing through the earlier stages, these companies have progressed along the "learning curve" and fully understand each others operations. A beneficial side effect from this understanding is that through importing some of the retailer's methodology, the supplier can improve their organisation and thus their service to the retailer. The trust-based relationship and commitment to supply chain integration encourages this type of organisational learning which can only be beneficial for the future.

6.2.3 QRL Model For The Future?

The real strength of QRL is the opportunity it offers. The future will bring further reductions in order-to-ship time. Companies that have reduced their lead times from say, one month to ten days will not be able to become complacent. Competitive pressures will

continue to drive down the time to replenish. Retailers want it - and leading suppliers will make it happen. This will require continuously available systems and networks.

One way to accomplish this reduction in lead times is with the next generation of EDI systems, which provide event-driven EDI (Agostino, 1993). Occurrences such as inventories falling to, or below, a specified level immediately trigger a chain of events, including automatic ordering from one company's application directly into others' applications, (something similar to 'trigger-selling' of shares at the stock exchange). The mailbox, batch-EDI system may no longer suffice under these time pressures. Some of the innovations originally targeted for improving distribution are also improving marketing effectiveness. Item-level data can be used in customer information systems to provide better marketing and merchandising information. In their special report on Retailing 2000, Management Horizons (Agostino, 1993) listed alliance management, technology management and speed/time management as the first three requirements for managers in the year 2000. Quick Response is proving itself a successful training ground for all these skills. Similarly, Drucker (1990:98) predicts that companies will be measured by a new accounting unit - TIME. This will be necessary as rapid response to customer requirements will continue to be all-important. (It is interesting to note here how Drucker (1990:98) in his new accounting model sees finished-goods inventory as a sunk cost, not as an asset.) Perhaps consumers do not want choices or options? They want and, prefer customerisation. It becomes the role of business to supply that customerisation in the shortest possible time.

Leading QRL companies may well be adding further stages to the model when they have fully understood and appreciated the benefits of their existing QRL-based processes. For instance, Sport Obermeyer claim to have increased their profit by up to 66% at a cost of less than 0.1% of sales by moving beyond quick response to *Accurate Response* (Fisher et al, 1994:48; Fisher, 1997:116). Accurate Response (AR) is a new concept that combines QR practices with a new planning paradigm that maximises profit by explicitly measuring forecast risk and then optimising production to minimise stockouts and markdowns. AR appropriately focuses attention on the *result* (accurately producing the styles and colours customers want by responding to early market signals), rather than the *means* (lead time reduction). One thing is clear, QRL has called businesses to challenge their traditional *modus operandi* processes and completely redesign their businesses by the use of cooperation with their suppliers and customers. The future for these companies will be one where their traditional operations will be unrecognisable.

One of the best ways to appreciate the difference that the QRL methodology makes to companies is to compare it with existing traditional operations.

6.3 Traditional Operations Vs Quick Response Logistics

Table 6.3 below is an attempt to describe the comparison between traditional retail business operations and how those same transactions would occur under the Quick Response Logistics philosophy. For convenience, several distinct areas/functions are compared, viz: operating philosophy; merchandisers; sales; manufacturing/distribution; information; finance; and design. To assist in understanding the comparison, the relevant QRL stages of the QRL model description are indicated in square parentheses at the appropriate places within the right hand column of Table 6.3.

As a further aid in the comparison of traditional operations and processes under a QRL environment Table 6.4 below compares the times of the stock replenishment cycle before and after Quick Response Logistics.[34]

6.4 Best Practice Quick Response

An example of how the use of effective QRL can be used to set new standards for businesses is reported by Seideman (1993): Canover, based in the USA, is a retailer to retailers. It sells a variety of supplies to outlets all over the country supplying items from paper towels to desks and pens. In the last few years the $70 million company has redefined itself. It has changed from being a manufacturer to being a logistics outsourcing company dealing in the science of inventory control, freight consolidation and product procurement. By using Quick Response Logistics techniques, the company has:-

- cut the cost for processing each order from $40 to about $4
- increased sales dramatically
- developed long term partnerships with both suppliers and customers
- gained new customers who have joined specifically to gain experience.

With rapid replenishment techniques and a commitment to supply chain integration, the company has increased inventory stock turns considerably. Automation was the key to making Canover productive enough to make the company's high speed style of business work. Goods moved so quickly through Canover that in some cases the company never owned them (i.e. cash neutral). Instead it charged a toll for the service of moving products.

More than 75% of Canover's orders in 1993 came in electronically. Of these a third moved via computer link-ups, a third came over PC-based EDI, and a third were issued through interactive voice response (IVR) technology. (Although many experts do not regard IVR systems as true Quick Response Logistics, the results are the same for both

[34] "Retailing and QR", *Trends*, July 1993

Traditional Operations	Quick Response Operations
Operating Philosophy:- Here, a retailer keeps its suppliers at arms length and carefully guards its corporate information. In addition, retailers only concentrate on optimising individual business functions.	Operating Philosophy:- Supplier/retailer relationships are restructured as partnerships, with each party sharing valuable customer and sales data [3] - both reap the benefits of the arrangement. Instead of a 'business as usual' attitude, retailers reallocate responsibilities and change any business practices necessary to implement the QR strategy [1,2,3].
Merchandisers:- Typically control merchandising on an aggregate basis and store personnel are charged with responsibility for shelf-maintenance.	Merchandisers:- Manufacturers participate in product-assortment tailoring at the store level and take some responsibility for the shelf merchandising [2,3].
Sales:- Manufacturers encourage retailers to forward-buy by providing price incentives. Large, specific orders are often tied into these discount deals.	Sales:- Manufacturers give retailers broad supply commitments with guarantees of no stock-outs, thus enabling retailers to receive replenishment based on actual rate of sale timed to closely match demand [1,2,3].
Manufacturing/Distribution:- Suppliers are geared towards long-runs producing large volumes, whilst maintaining buffer inventory to account for unexpected orders. Retailers maintain distribution centres (DC) to receive these high-volume shipments, break the orders down into store assortments, deliver the goods to individual stores, and prepare the merchandise in the back room for display.	Manufacturing/Distribution:- Flexibility on the part of both manufacturers (at plant level) and retailers (at distribution centre (DC) level) enable shifts in demand to be met without the maintenance of a large inventory [3]. Dynamic delivery flow allows goods to be shipped to either a DC or direct to the store in cases or other units (e.g. various stock keeping units (SKU)) and shelf-ready to minimise preparation at the store [1,3].

Table 6.3 (Part 1) Traditional Vs Quick Response Logistics Comparison

Traditional Operations Continued	Quick Response Operations Continued
Information:- Standard retailer and supplier relationships are defined by suppliers using statistical forecasts to drive production and provide adequate inventory and, by retailers generating orders centrally to support aggregate demand - with each party maintaining separate information systems.	Information:- Extensive use of appropriate information and communications technologies like EDI gives suppliers and retailers simultaneous access to PoS or DC withdrawal data [1,3], which results in significantly shortened response-times and store-specific orders that are rolled up into appropriate replenishment quantities [2].
Finance:- Retail buyers base their purchasing decisions on gross margin and do not consider the global implications of the whole supply chain.	Finance:- Retailers measure financial success by net profitability, considering the implications of the whole supply chain [3].
Design:- Manufacturers who have designed their products offer their range of products for the retailer to buy, and/or retail buyers use their own sales data and commercial acumen (market awareness) to request the design of new products - which are then manufactured. There is little interaction between the design house, the manufacturers and the upstream activities.	Design:- Joint product development takes place [4] where shared data is used to determine actual sales of specific product styles, colours, and sizes which can be sent to designers and manufacturers to design similar products [1,3]. The demand for more product variety is met with sophisticated design and manufacturing techniques.

Table 6.3 (Part 2) Traditional Vs Quick Response Logistics Comparison

Pre-QR	TIME (Days)		QR
Item Sold	-	-	Item Sold
Create, approve and mail purchase order (PO)	20	4	Create and transmit order via EDI
Enter PO, pick and ship order	15	4	Receive PO, pick and pack UPC - ticket by store using UCC, and ship order
Ship to warehouse	10	3	Ship to warehouse
Receive, count, apply price tickets, assort by store, and ship	14	2	Receive and cross-dock
Receive at store, restock shelf	3	2	Receive at store, restock shelf
	TOTAL		
	62	15	

Table 6.4 Stock Replenishment - Traditional Vs Quick Response Logistics

methods.)

Canover recognised that QRL was an organisational issue and as such, created the infrastructure to manage it - with a Quick Response Logistics department and senior management representation. Christy Clark, Director of Quick Response, says that the order system is "completely painless". Orders are received without manual intervention meaning that the people working at Canover can do a lot more than simply take orders. Customer service representatives can now actually focus on being with customers, providing pro-active service and acting as a help-desk.

IVR technology proved especially useful when unanticipated sales left many retailers short of supplies during the holiday season of 1992. Canover reached a peak of 4 000 orders processed in a single day, up from a maximum of 300 four years previous. An excess of one million cases were shipped in a single month. More than $8 million in billings were handled with $145 of phone charges; no stamps, invoices or paper.

Every case that leaves one of the four distribution centres has a barcoded label on its

side. Before that case moves off the loading dock, an electronic advance shipping notice (ASN) is transmitted to the customer. When the store receives the goods, they scan the barcode information into their system; it is then matched up against the ASN. Total turnaround time from when the customer places an order until payment arrives at Canover is about 12 days, compared to over 45 days before Quick Response Logistics.

There is one major problem with Canover's set-up at present, however. They had decided to connect to their suppliers and customers by using direct connections. When they realised the benefits of electronic trading, others wanted to connect as well. The method used to roll-out was through direct connections. As a consequence they have a myriad of direct connections which could easily be solved by using a value-added network (VAN) and giving suppliers access to it.

6.4.1 Is ECR The Panacea For The Grocery Trade?

Whilst all the theory and logic of QRL and ECR suggests that it is a panacea and that changing to it is not an option - but a necessity (Partch, 1993:29), the system/procedure does have its opponents. The principal argument to counter ECR is the price benefits of the 'forward buy' (buying large volumes at highly discounted prices). As Richard Lester, Vice President of MIS for Associated Grocers (a distributor) of Seattle, USA, who commented on ECR (in Partch, 1993:32) revealed: "We made more in forward buy last year than we did on the bottom line. That's why it's going to have to be done in baby steps through partnerships - confidence-building steps - and work out systems that measure things accurately and openly. Even if it doesn't work 100 percent perfectly, we're still going to take significant cost out of the system. Remember, as a wholesaler we don't add anything to that product except cost. That's why we have to be very careful about what we do. We have to make sure that we don't add any unnecessary cost to getting that product on the retailer's shelf." So the cardinal drive still appears to be cost reduction striving to achieve what the industry calls everyday low prices (EDLP) - or, more accurately, everyday low costs (EDLC).

Brown (1993:26) agreed that the cost benefits (and hence the competitive advantage) of forward buys would not be outweighed by ECR. He also pointed out (Brown, 1993:26) that the 'shipping notices' were not a saving but a cost issue; the reason for this was that shipping notices advised the differences from what was ordered and what was being sent/delivered. If the delivery was exactly what was ordered then there would be no need for a shipping notice. The argument is that the shipping notice is a *cover-up* for not being able to fulfil completely the original order. Another downside to ECR was that manufacturers who wished to move their products would finance (i.e. via price support) the promotion of that product, but with ECR any promotional costs would have to be borne by the distributor - especially in the face of other offerings of promotional support. Brown (1993:26) concluded: "It's tempting to follow their lead - we could save

time and effort; the mass merchandisers' success would seem to validate their approach; there are plenty of experts holding up other trade classes as shining examples of admirable supply chain management ..." He (Brown, 1993:26) referred to these other examples as "alternate formats", and he concluded with: "Supplier-controlled replenishment, by "forcing" a migration to EDLP, would level this playing field. The question is: Is that what you really want? Do you *want* to trade your present buying flexibility for the strictures that across-the-board EDLP would impose? It's a question worth asking, with implications worth exploring. Particularly in regard to supplier-controlled replenishment, it's a mistake to assume that simply because the mass merchandiser does it, it's the right way to go."

ECR is prevalent in the US where the dominance by the manufacturers has allowed them control of the supply chain/network. In many cases they are given responsibility of the entire supply chain/network, where retailers allow access to any information they need to keep stores supplied at the lowest cost. For example, one successful partnership is that of Procter & Gamble (P&G) and Wal-Mart, where 15% of P&G's total US sales are sold through Wal-Mart stores. In the UK, retailers tend to control the supply chain/network instructing manufacturers where, when and how much product they want.

One aspect is clear, that any implementation of ECR involves culture changes, as Richard Lester (in Partch, 1993:32) admitted: "For us, it's going to mean a total culture change." Therefore, any introduction of QRL or ECR needs to be planned and implemented with a proper modern change management programme and philosophy.

6.5 Quick Response Logistics Report From The European Commission

According to a report[35] from the European Commission, the soft goods (i.e. clothing, shoes and home textiles) sector has an annual sales turnover of circa 110 billion ECUs, equivalent to 4% of total manufacturing industry. It employs some 2.3 million people or 7% of total EC manufacturing employment. The Commission's study looked at 217 companies in seven EC countries.

The sector tends to be polarised between a few large companies and many small and medium sized enterprises (SMEs) although concentration, in general, is increasing across Europe. The necessary investment in Information Technology (IT) for Computer-Aided Design (CAD), automated manufacturing and communications systems is seen as a barrier to SMEs.

Trends such as the increased internationalisation of soft goods companies, higher

[35] Kurt Salmon Associates Inc., "Encouraging the competitiveness of the soft goods industries through cooperation in the post-1992 European Community."

sensitivity of consumers to fashion which requires shorter planning cycles and the increasing need for integration of the supply chain, have lead the industry to look to IT, particularly to Quick Response Logistics and the use of Electronic Data Interchange.

Improving deliveries and controlling manufacturing costs were found to be vitally important for soft goods companies. Flexibility in manufacturing and sourcing is also increasingly important. Establishing links with customers and with internal sales organisations ranked low in the concerns of companies studied and, currently, is limited in this sector. The report states that the total process cycle of clothing, from raw materials to retail store averages 66 weeks and that around 83% of this total cycle is waiting time. The implementation of QRL is suggested as the remedy for this problem. The acceptance of QRL techniques and EDI in the soft goods sector is very limited. Lack of industry agreement on standards, the unsuitability of the EAN numbering system and the absence of inter-industry committees are cited as barriers to progress. (This view is supported by Ko and Kincade (1997:97) who concluded from their US study: "Future research is needed to develop an integrated model, including the perspectives of manufacturers and textile producers, because trading partners in the apparel complex are related. Specifically, identification and standardization of technologies used by manufacturers and textile mills are needed for better channel service.") The report states that QRL is probably the single most important development for the European soft goods industry and distribution.

6.6 Summary

Point of Sale (PoS) information stored in databases facilitates product/brand tracking, assessment of promotion campaign effectiveness and forms the basis of consumer (i.e. store) loyalty schemes. It also triggers stock replenishment and allows analysis of the optimum mix of 'stock keeping units' (SKUs) - i.e. much sought after information about product/brand variants based on package type/size, product form/colour, flavours, and many other attributes. By sharing this information with other chain/network constituents, greater total chain/network efficiency and effectiveness can be attained/obtained/achieved.

The ideal response in logistics terms is when that response is directly proportional to the demand pattern (i.e. such that an Economic Batch/Order Quantity equals one). Quick Response Logistics is a methodology which involves the sharing of 'up to the minute information' between companies in the supply chain/network. Effective QRL involves the constant monitoring of product consumption and quickly and regularly replacing items that are selling by using barcoded tickets and container labels, and exchanging electronic documents. The ideal is reached when the response is directly proportional to the demand/consumption.

QRL is built on a new kind of trust-based relationship between companies and on redesigned business processes throughout the entire supply chain. These relationships are supported by just-in-time delivery concepts and flexible manufacturing in small lots to synchronise the flow of goods in a 'legato' *seamless* arrangement to match retail customer demand. Excessive lead times in the US apparel supply chain led to the development of the QRL strategy.

QRL can be viewed in five stages of sophistication though (probably) few have attained its highest reaches. The stages relate to increasing degrees of partnership commitment and recognition of the benefits of supply chain cooperation via 'legato style' (or 'seamless' operational) arrangements. QRL has allowed businesses to challenge their traditional business processes and completely redesign their businesses by the use of cooperation with their suppliers and customers.

Large scale grocery distributors see one downside, that is the loss of significant volume discounts on non-perishable and long shelf-life products which is how they are able to continue being profitable currently. Obviously, QRL fits best where products are highly fashionable, have a short shelf-life and have a volatile demand pattern in the market.

It is very likely that because of the five stages involved in QRL, different companies have different perceptions as to what Quick Response Logistics is and what it involves. It is also likely that QRL is strongly sought by the UK Textile companies. Technology - predominantly computerisation - is merely an enabler, although some like Hughes, Ralf and Michels (1998:147-166) consider QRL as part of *"The Electronic Supply Chain"*. It is inevitable that a move towards partnerships is preferable due to the demanding retailer requirements and the competitive dynamics of the apparel sector. As Hughes et al (1998:161) stated: "Efficient consumer response (ECR) is about re-engineering the relationships across a complete supply chain to achieve a more appropriate focus on customer or end consumer requirements. It involves all of the companies in that supply chain, or at least the major players, working together to fulfil consumer expectations - better, faster, more responsively and at lower cost." Notwithstanding the following insight applied to humans, the substance is just as powerful for seeking logistical solutions, when Ohmae (1982:13) commented: "... what marks the mind of the strategist is an intellectual elasticity or flexibility that enables him to come up with realistic responses to changing situations, not simply to discriminate with great precision among different shades of gray." Sustained competitive advantage via logistics (and the other disciplines) requires a flow of evolving managerial thinking, routines and/or capabilities in response.

Before venturing further, it is worth considering the variables of logistics; these are discussed in the next chapter once the dimensions of logistics have been outlined.

7. THE VARIABLES OF LOGISTICS

"Just as water retains no constant shape, so in warfare there are no constant conditions."
Sun Tzu (circa 400-320 BC)

All the work carried out so far, (from the initial inquiry, through the historical evolution of logistics, the explanation and description of the pertinent theories, and the quick response logistics delineation), always contained the *basic* variables of logistics and, in some cases new variables emerged. This chapter begins with the relevant dimensions of logistics found until this point and then consolidates the variables of logistics that have emerged from/in the two sectors - i.e. defence and business - by portraying and displaying them in a novel manner - in order to aid comprehension - prior to generating hypotheses which is the purpose of the following chapter - i.e. Chapter 8.

7.1 Introduction

What is a logistics variable? To answer this question it is necessary to start with concrete representations of abstract theoretical concepts of logistics - known as operational definitions. When an operational definition of a concept is established, then that becomes a variable. Dane (1990:33, 339) describes a variable as a measurable entity that exhibits more than one level or value. So,*variability* would be the term used in situations where an entity exhibits many different values within, or over, a time period.

7.2 Dimensions Of Logistics

Initially, it is helpful to understand the dimensions involved. So, taking a dimensional analysis approach using the symbols: L, W, T and C denoting length, weight, time and cost respectively, Table 7.1 lists most of the absolute and derived dimensions (plus their units) encountered within the sphere of logistics. Taking these one by one, a little explanation will aid comprehension and prepare for the discussion on operational definitions (or variables) which subsequently follows.

Time can be the 'waiting period' for goods to arrive or, it can be the 'duration' of achieving an end result. 'Shelf-life' is the time period for which a product's condition is acceptable, i.e. the product is perishable. Time can also be a 'specific point' in time for a synchronised event, meeting or coordination. Length can be the distance between point of collection (PoC) and point of delivery (PoD) and it can be an item's measurement from end to end. Velocity is the change in distance with respect to time; it is the actual speed of the method of transport. Area can be the horizontal or level space of a warehouse or marshalling site. The 'footprint' of pallets, stillages and containers is also an example of the use of area. Volume is the three dimensional (i.e. vertical and horizontal) space of a warehouse, lorry/truck capacity or the solid content of products.

Dimension(s)	Symbol	Units
Time	T	seconds (s), hours (hr), days (d), weeks (wk), months (mth), etc.
Length/Distance	L	metres (m), kilometres (km), etc.
Velocity/Speed	L/T	metres/second (m/s), kilometres/hour (km/hr), etc.
Area	L^2	square metres (m^2)
Volume	L^3	cubic metres (m^3)
Item	It	a discreet object or an order/delivery entry
Stock Keeping Unit	SKU	unit of pre-packed multiples: items/box or items/container
Weight	W	kilogrammes (kg), Megagrammes (Mg) or metric tons (Tonnes)
Density	W/L^3	kilogramme/cubic metre (kg/m^3)
Cost or Money	C	UK pounds (£) or US dollars ($)
Value Density	V	kg/£ or kg/$; m^3/£ or m^3/$
Carriage Charge/Cost	CC	£/kg or $/kg
Capacity/Flow Rate and Usage Rate or Consumption Rate	It/T) W/T or L^3/T)	items/hr or kg/hr or m^3/hr (items/d or kg/d or m^3/d) etc.
Headcount	H	number of people available/required to run the logistics operations
Right Product/Identity	ID	universal product code (UPC); barcode; European article number (EAN)
Right Quantity	Q	items; number off; number of packs; weight; volume; (No. or kg or m^3)
Right Time	T_1	specified day and/or hour
Right Place	X	specified address or map reference
Right Condition/State	S	undamaged and in good condition
Right Performance	P	a variety of customer service measures and, process/productivity benchmarking

QUALITY

Table 7.1 List Of Logistics Dimensions

An item is a discreet object or an order/delivery entry. A stock keeping unit (SKU) is a unit of pre-packed multiple, e.g. a packet of 10. Weight is the heaviness of an item, or unit, or collection of products. Density is the weight ratio of compactness or bulkiness of something. Cost is the monetary value of whatever, i.e. material, product or process. Value density is the amount of product obtained per unit cost. Carriage charge is the price paid per unit weight or volume of an object/item for its transportation. Capacity flow rate is the supply consistency, whereas usage rate or consumption rate are measures of material devourment. Obviously people are required to run a logistics operation and aspects like warehouse management are very labour intensive. Headcount is a variable that has a direct impact on the total cost of logistics by way of wages/salaries, national insurance, pensions and with respect to productivity achieved per person.

Using the symbols in Table 7.1 it can be seen that for a given speed (i.e. a velocity that is achievable by a particular transport mode within the conditions appertaining) and a given destination distance, the required time (i.e. transport lead time) needed to get goods to the destination is:-

Transport lead time = Distance / Achievable speed

i.e. Time period required **[T]** = Distance **[L]** / Speed **[L/T]**

It will be noticed that **[L]** cancels leaving **[T]**.

Another example is the quantity of inventory necessary to sustain a certain flow (or consumption) rate for a given time period is:-

Inventory quantity required = Flow (or consumption) rate x Time period

i.e. Amount required **[Q]** = Flow (or consumption) rate **[Q/T]** x Time period **[T]**

It will be noticed that **[T]** cancels leaving **[Q]**.

The final six listed in Table 7.1 are the quality dimensions of: right product, right quantity, right time, right place, right condition and right performance. One other (the seventh) quality variable not included in Table 7.1 is 'right price' (or 'right cost'); it has been left out because it is usually a resulting gestalt of the concomitance of all the other variables affecting logistics.

7.3 Performance Indicators And Benchmarking

A performance indicator has been defined by Hoekstra and Romme (1992:154) as a: "Variable used to indicate the efficiency and/or effectiveness of part or the whole of a process, an organization or a system, against a given norm: e.g. logistic performance indicators such as delivery reliability, lead time, stock." With regard to performance, two ways of viewing this can be offered: (i) these can be measures and accomplishments to be achieved as specified within service level agreements (or standards), including quality required by the customer/end user; and (ii) performance measures (or ratios) derived from the particular dimensions in Table 7.1, (e.g. in a warehouse operation, a

performance measure that could be used is: the average number of items picked per person per day (i.e. It/H/d)). Six indicators or measures used most are: absolute counts; productvity; time based; quality; service and; financial/cost based. Christopher (1985:69 and 1992:57) envisaged an 'output' oriented approach to accounting, whereby activities become more result oriented and thereby improve financial performance in contrast to traditional functional 'input' oriented measures. Two good treatises on performance indicators and measurement for logistics are given by NEVEM (1989) and Mentzer and Konrad (1991). Many logistics performance and productivity studies have been carried out by Professional Bodies and, Consultants like A.T. Kearney (1984 and 1978).

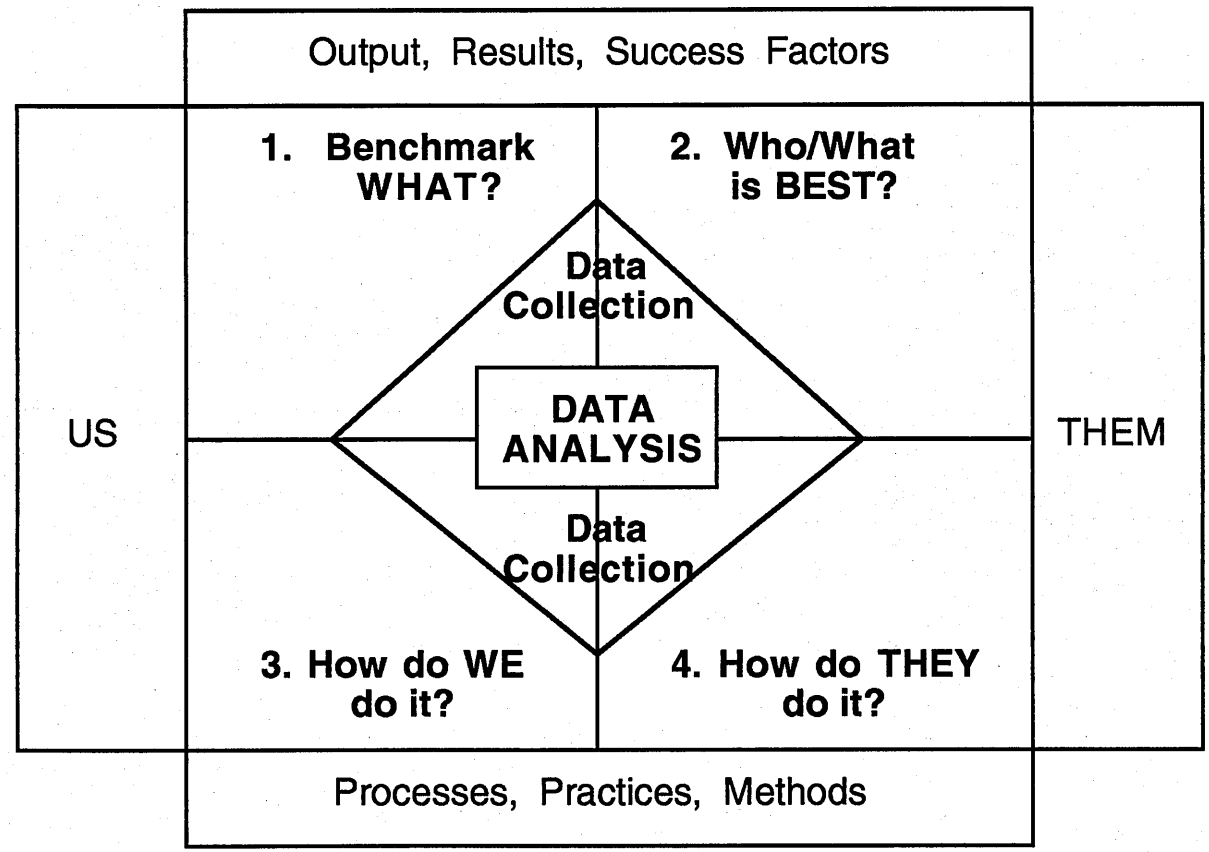
A measure that is in vogue is *turnover-of-stock* which is an indicator of stock usage; it is computed by the following formula:-

$$\text{Turnover of stock} = \frac{\text{Cost of goods sold in a specified period}}{\text{Average cost of stock for the specified period}}$$

For an enterprise, the cost of goods sold is calculated for a specific period and, the average stock figure is usually the average of stocks held at the beginning and end of that specific period. However, when there is a strong seasonal element (e.g. a toymaking company where perhaps 60% of the output is sold spanning the calendar year end from late October to mid-January (i.e. the Christmas season)), it is necessary to calculate a more sophisticated average. Generally, the higher the turnover-of-stock ratio, the more efficient is the stock management of the enterprise. Nevertheless, a relatively high stock-turnover ratio may be the result of too low a level of stocks and frequent stockouts. Such a circumstance could be more costly for an enterprise than carrying a larger level of stocks and having a lower turnover ratio. When the stock-turnover ratio is relatively low, it may indicate slow-moving stock or obsolescence of some stock. Obsolete stock(s) may necessitate large 'write-offs', which would affect both the net assets of the enterprise and its profitability. The stock-turnover ratio is a generic measure and as thus it is suitable for process *Benchmarking* purposes.

Benchmarking is the procedure of comparing results, outputs, methods, processes, quality or practices in a systematic way. It was first developed/derived by Rank Xerox and their original 'Benchmarking Template' is shown in Figure 7.1. *Internal* benchmarking compares all the systems/aspects of a similar nature in-house, or between sister companies/organisations; whereas, *external* benchmarking compares all systems/aspects of a similar nature to those of/by outside bodies/companies or competitors. Benchmarking is therefore another way of monitoring and improving logistics (and other) operations and overall performance, but it depends on the willingness of other owners and/or operators (i.e. in associations, partnerships, clubs or consortia) to share their data for comparisons and comments. This willingness has been

(The author defines benchmarking as: *"The search for a superior process from either inside or outside an organisation with the sole intention of learning from the benchmarking experience so that it leads to an enhanced product (and/or service) and performance aimed ultimately at benefiting the customer. This is acheived by highlighting critical success factors and developing both the methods and systems to improve the attainment of them."*)



Rank Xerox defines benchmarking as: *"A continuous, systematic, process of evaluating companies recognised as industry leaders, to determine business and work processes that represent best practices and establish rational performance goals."* (From: Zairi, 1994:61 note 4)

Figure 7.1 The Rank Xerox Benchmarking Template

lacking of late, as Partch (1993:34) commented: "The FMI/ECR[36] study makes a point of the need to communicate Best Practices, so that developments do not have to be continually repeated from scratch. Considering the relative secrecy that has prevailed over industry practices of late, this is a basic change in trade attitude in itself. Then again, when an industry hasn't really been in the forefront of breaking new ground, perhaps silence is the best policy." The idea of benchmarking is that it works on the principles of: having defined for the organisation the limits of good (i.e. acceptable) and bad (i.e. not acceptable), it becomes possible to measure and ascertain the limits of all processes and functions and deduce the ideas and outcomes of their proportion and equality to a given standard. Thus what an organisation observes as being praiseworthy in others (competitors or users of similar (generic) processes) it will carefully imitate, and what in those organisations appears defective, it will attempt in itself to amend. A quintuple decadal evolution of enterprise benchmarking is shown in Table 7.2; logistics has had an impact on all of the measures in all five decades. From Table 7.2 it can be seen that there have evolved three types of benchmarking which are in general use today: strategic; performance (i.e. *balance sheet* and *profit and loss* related); and process (which includes quality).

Decade:	1950s	1960s	1970s	1980s	1990s
METHOD	Product Cost Comparisons	Internal Financial Analysis	External Financial Analysis	Performance Benchmarking	Best Practice or Generic Benchmarking
MEASURE	Cost versus Competitors	This Year versus Last Year	Return on Investment (RoI) versus Competitors	The Worst to the Best	Existing versus Best Practice

Table 7.2 The Historical Evolution of Benchmarking

Using three anonymous case studies, Foster (1992) showed how benchmarking can be used for a number of reasons. These are to: highlight better practice within an organisation; gain insight into a company's operations; look at distribution from a cross-functional perspective; and measure performance in order to improve it.

7.4 Variables Of Logistics And Their Ramifications

7.4.1 Variables

Table 7.3 lists the variables encountered within logistics. Time in the guise of 'lead'

[36] FMI = Food Marketing Institute; and ECR = Efficient Consumer Response.

Variable	Concept	What Does It Mean?
'Warning Time' or 'Lead Time' / 'Rate of Change'	Readiness/Availability, Flexibility and Mobility	immediate response?
'Variability'	Concurrence	i.e. capacity ≠ demand
'Protraction'	Endurance	i.e. capacity < demand
'Flow' (Supply and Usage)	Control	visibility (track and trace); point of collection (PoC); point of delivery (PoD); attrition; Main Supply Routes (MSRs)
'Situation' (Fixed or Variable)	Intelligence/Information	i.e. warning time < required response time
'Packaging'	Product Protection	crush proof/impact resistant, dust proof, water proof, shrink wrap, etc.
'Hazardous Nature of the Product(s)'	Danger/Accidents	safety in handling and transportation; special requirements/needs?
'Mode of Transport'	Speed/Economy, Accessibility and Ease of Handling	road, rail, air, water (sea, river, canal), pipeline
'Size of Fleet'	Transport Capacity	appropriate bulk quantities
'Composition of Fleet'	Scope, Flexibility and Matching	appropriate vehicle/lorry/ship/aeroplane for the defined tasks
'Scale of Operation'	Magnitude/Size	magnitude, size, intensity and scale of support and sustainment
'Reach' , 'Range' and 'Sweep'	Strike Distance and Distribution Area Coverage	reach, range and sweep capability under a certain set of conditions
'Headcount'	Manual Capacity	people capacity for the relevant people tasks
'Training Level'	Competence	properly trained/qualified people to carry out the necessary tasks
'Energy Type/Source/Means'	Propulsion/Heat Means, etc.	ease of supply, applicability, petrol, diesel, electricity, gas, batteries, etc.
'Utilisation'	Optimisation/Best Use	method of use and full employment proportion of the resources

Table 7.3 List of Logistics Variables

time defines the waiting period from order request to goods received. 'Warning' or 'reaction' time is the period of time available prior to some event happening. Rate of change is the speed at which matters are progressing (or have to progress): as a military illustration see Figure 7.2. In Figure 7.2 there is a logistics activity level/capability curve for a peace footing, i.e. State 1; should a war ('Time of Tension' (ToT)) be declared then the logistics capability/activity level needs to be elevated to a war footing, i.e. State 2. It is very rare that a step (i.e. instantaneous) change takes place at time T_1. It would be normal for a timed change to occur, i.e. a change from State 1 to State 2 in a time period of T_1 to T_2. This 'Transition to War' (TtW) time is dependent on the rate of change of capability/activity level over the time phase it takes. As an example of this, in the Gulf War of 1990/1991, Menarchik (1993:174) commented: "For strategies to go from deterrence to defense to offense required massive logistical adjustments." The finite warning/reaction/lead time and rate of change variables are factors relating to the concepts of readiness, availability, flexibility and mobility, and which lead on to a class of response, hopefully, as near as possible to an immediate response?

Variability is the situation when a variable differs (i.e. it takes on different values) over time and relates to the concept of concurrence - or more correctly in this case non-concurrence. In the case where capacity falls short of demand, problems and concerns about sustainment arise; and having surplus capacity can be wasteful, uneconomic and hinder mobility in the form of 'logistics drag'. For a protracted campaign (or operation/project) the endurance concept emerges because capacity is far short of demand and the economic principles of handling scarcity become prevalent, like some rationing, 'stretching', allocating or substituting of resources/materials. These are congruent necessities to obtain the most effective outcomes (profit or advantage) of the limited resources/materials. Again, from the Gulf War, Menarchik (1993:173) analysed: "The nexus between logistics and strategy was location, timing, tempo and outcomes. The crisis location often shaped the logistical system and the type of response."

Material flow - both in supply and consumption - unfolds the concept of control. If a 'steady state' or consistent scenario exists where supply and consumption are equal, then no volatility or 'wild swings' have to be managed. Volatility and wild swings generate vast control problems which reverberate throughout the whole supply chain/network system. Facilities for material/stock/product visibility via 'track and trace' technologies become productive assets for aiding management decision making and appropriate allocation. Point of collection and delivery (PoC, PoD) stipulate start and end points. The disappearance of material/stock - i.e. attrition - by accidents, damage, theft, lost at sea, commandeering and interdiction offer management and control challenges to resupply. The planning for, keeping open and maintenance of main supply routes (MSRs), via parallel alternatives and 'back doubles', provide access to the PoD, should a prime route be impassable. This would also offer variations of thoroughfare,

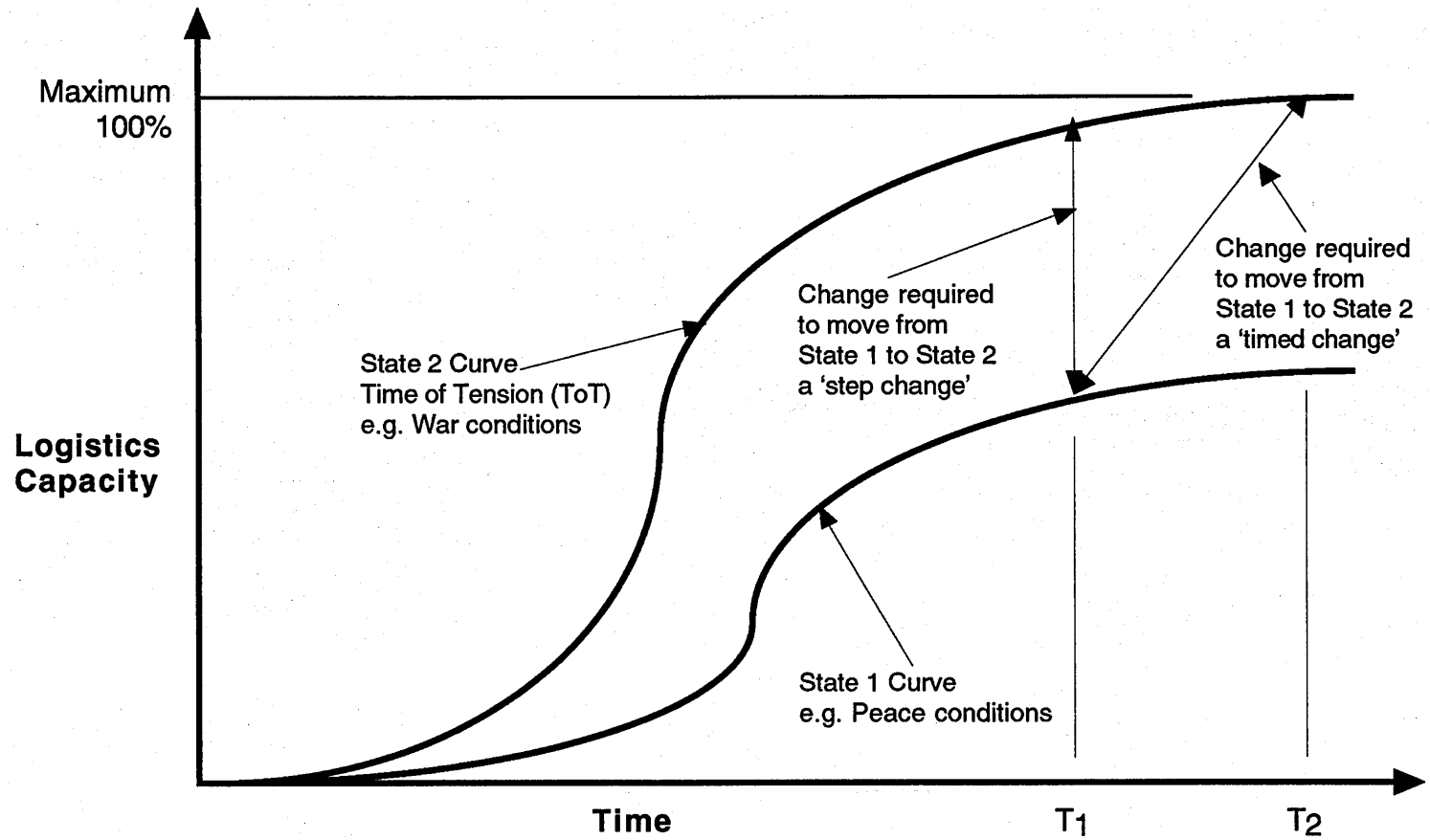


Figure 7.2 Rate of Change Illustration - Transition To War (TtW) in Time of Tension (ToT)

thus avoiding observed consistency and regularity, which could be a threat to security.

The 'situation' as a variable is to do with matters being fixed or variable/changeable. Contexts of a fixed nature are easier to plan for as major changes or fluctuations seldom occur; on the other hand, contexts of a variable (different values over time) nature cause schedule management and control issues, which are proportional to the magnitude of the disturbance. The forewarning of the prevailing circumstances is a function of intelligence and/or information. Matters are intensified if a situation arises where the warning time is less than the required response time, which could result in a lost opportunity or other damaging aspect(s).

For product protection, secondary packaging is a variable and sometimes it is designed to aid dispensing/decanting too. Appropriate packaging can be selected from: shrink wrap; crush proof/impact resistant; dust proof and shower/water proof. Also, in great demand these days is labelling and bar-coding attached to the packaging/container with the necessary details of: product description; part number(s) - there may be different part numbers for the supplier and the receiver; quantity contained; some coding (e.g. colour coding) for 'first in first out' (FIFO) stock rotation; possibly, just-in-time (JIT) kanban cards; and details of hazardous substances if applicable. Hazardous materials may require special handling, packaging and storage facilities and/or conditions, in order to minimise any danger. The necessary storage conditions may be energy intensive/costly.

Henderson (1905:1) stated: "War is first and foremost a matter of movement." He was thinking, no doubt, in terms of strategy and tactics, but his words are true for logistics also. Mode of transport offers the choice of speed, economy, handling (e.g. containerisation versus iron ore bulk) and sometimes it is constrained by terrain and the accessibility available at the PoC and/or PoD. The size of fleet is related to the capacity that can be handled/transported; whereas composition of the fleet offers various modes of transportation, thus increasing the scope and flexibility with matching of the right type and size carrier to the bulk/weight capacity required. The scale of operation relates to the size and the necessary attendant magnitude of logistics support and sustainment.

The reach, range and sweep connote the distance forward (i.e. radius) from a given point/depot that can be achieved and the area that can be covered (i.e. distribution coverage), with given resources under a certain set of conditions (e.g. terrain, environment and weather, need to be undetectable, acceptable response/lead time, capability of achieving the end mission, and drag, etc.) which impose various constraints/difficulties. Headcount forms the manual capacity and has already been discussed above by its inclusion in Table 7.1. One way the military compares its headcount is by the 'teeth' to 'tail' ratio; as Macksey (1989:1) described: "... the contest which, from the dawn of military history, has been waged between those strategists and

operational commanders who desire mainly to put all their assets into fighting, 'teeth' arms and the administrators and quartermasters (whose warnings that to do so courted logistic disaster) who so often had seen the logistic 'tail' services cut to the bone." Many historical examples of military devastation caused by the incorrect 'teeth to tail' ratio management are given, illustrated and commented on by Macksey (1989:10, 25, 33, 39, 61, 100, 106, 112, 128, 133, 135, 168, 188, 192). Some comparative examples of teeth to tail ratios for WW2 have been made by Dear (1995:697): "While eight soldiers were needed in a European Army to keep one fighting, about eighteen were needed to keep one US soldier fighting in the Pacific. Such huge engineering tasks as building the Ledo Road in Burma and the vast distances involved in shipping supplies across the Pacific undoubtedly contributed to this imbalance, but by contrast the Japanese often employed only one man to keep one soldier fighting." (It is probably from these ratios that the Direct to Indirect headcount ratio for a manufacturing operation emerged. The Direct head actually adds value, whilst the Indirect head supports the value adder.) These ratios are common benchmarkers and used frequently in industry for comparative purposes.

The teeth to tail comparison has been debated by many researchers and they comment on the elusive goal of achieving 'balance'. Huston (1966:674) commented: "It has become common to make the ratio of combat troops to service troops a measure of efficiency in the Army. By itself this ratio means nothing. What counts is the total amount of effective fire power that can be brought to bear against the enemy. If the greatest total of effective power can be delivered with one combat man for each service man then this is the desired ratio, but if 1,000 service troops for one combat man are needed to achieve that maximum, then this is the desired ratio. If it impairs combat effectiveness to maintain a small ratio of service to combat troops then such a ratio is to be avoided rather than sought. The concept of the division slice, that is, the average strength of a combat division plus proportionate shares of supporting troops, is useful in estimating troop and supply requirements for preliminary planning, but it cannot be taken as any kind of standard for a particular situation. It is impossible even to suggest a desirable ratio of service to combat troops. Obviously many more service troops will be needed in one situation than in another, and the number will vary according to whether good transportation facilities are available, whether roads and railroads must be built, the length of the supply lines, the availability of local labor, the type of operations being supported, and other factors which cannot be anticipated. Furthermore, the implication which some may read into the division slice that the proportion of overhead troops to combat troops remains constant even in a given situation is unwarranted." Huston (1966:677) concluded: "The way to become "lean" and "streamlined" and "highly mobile" is not, as has so often been assumed, to reduce the proportion of service troops. The more likely way to develop a fast-moving, hard-hitting force is to give it enough service support."

Again, with respect to the balance in WW2, Ruppenthal (1959) commented: "The problem of balance applied with equal force to the troop basis. The objective at all times, of course, was to maintain the highest possible ratio of combat to service forces in order to achieve the greatest possible combat potential. The War Department, always fearful that the theater might become top-heavy in service troops, never stopped urging the theater to "comb its tail" and "sharpen its teeth." But achieving the perfect balance was an elusive goal. The ratio naturally will vary with circumstances. Combat commanders, although recognizing that developments in warfare of the past century have reduced the proportion of a total force that can be put into the front line, never ceased to demand a larger slice of the total manpower allocation, as was evidenced in the premature acceleration of the divisional build-up on the continent in the late summer and fall of 1944. Within the Communications Zone, meanwhile, each technical service, concerned primarily with its own mission and desirous of providing perfect service, naturally tended to exaggerate its own needs and asked for the largest slice of the manpower pie which it could justify. The sum total of "minimum" requirements invariably exceeded the authorized troop ceiling. Resolving such conflicting demands usually calls for an arbitrary decision. Unfortunately the wisdom of the allocation must always await the test of operations."

Returning to Table 7.3 and continuing with the remaining variables it contains; the appropriate training level matches the cost outlay, or investment, for the right performance competence of people employed in the logistics operations. Energy requirements are many and varied. Warehouses and, special storage conditions can be very energy intensive. Propulsion of vehicles and equipment like generators (for producing electricity) are vast consumers of petrol and/or diesel. The source, transport, safety and storage of the 'fuels' requires considerable planning itself. The British Army is currently studying the possibility of propelling all its vehicles and equipment via one grade of fuel thus reducing the sustainment varieties and complexities involved - standardisation breeds simplicity. Power packs and batteries are another source of stored energy but are usually very heavy and may have disposal problems. The final variable in Table 7.3 is utilisation which pertains to the use optimisation of equipment and manpower; i.e. the best use and full employment ratio of all the resources within a logistics operation. This should not ignore the fact that, and the need for, *spare* capacity planning for 'surge' situations that may arise, or can be predicted.

7.4.2 Overshooting And Undershooting Of Logistics Density

Forty years ago, Forrester (1958:37) wrote: "Management is on the verge of a major breakthrough in understanding how industrial company success depends on the interaction between the flows of information, materials, money, manpower, and capital equipment. The way these five flow systems interlock to amplify one another and to cause change and fluctuation will form a basis for anticipating the effects of decisions,

policies, organisational forms, and investment choices." Using similar principles that Forrester (1961; 1958) used, that is the 'out of phase' flows of the actual compared to the desired (i.e. the ideal), Figures 7.3 and 7.4 were constructed to help conceptualise and describe logistics responses compared to the demand requirements (the ideal).

In Figure 7.3 is portrayed the concept of logistics *overshoot*. In this case, the logistics response profile, when compared to the demand (i.e. ideal) profile, shows an earlier response than is required/needed. What occurs is a logistics advance, that is the goods or services are provided at an earlier time than is necessary; and the logistics level (or density/capacity) employed is higher than is necessary, constituting a logistics overshoot. An overshoot results when more resources are employed, or a much better service is provided, than is necessary - i.e. spare/surplus capacity and/or extra expense. Naturally, the course of action taken is to correct for such a mismatch in order to bring the two curves together. Usually, this means a progressive attenuating response until coincidence is achieved.

Figure 7.4 portrays the concept of logistics *undershoot*. In this case, the actual response is tardy (i.e. late) when compared to the ideal or required demand response. The result is a time delay for the goods or services to be provided (i.e. they are overdue). A probable cause for the overdue could be the insufficient resources (including not having the right infrastructure) available to respond with celerity. This is the concept of logistics undershoot or, a 'logistics shortfall/gap'. Action is taken to correct for the mismatch by an appropriate increase in the logistics level (or density/capacity) - resources permitting of course - and a possible small overshoot occurs, with the resulting progressive attenuation until the two curves become coincident.

7.4.3 Ramifications

Returning to the operational concept of warning/reaction/lead time, for a military scenario, Table 7.4 sets out a conceptual model of the duration of warning/reaction/lead time and its interrelationship with the impact on the variables of 'need', 'rate of change', 'variability', and 'protraction'; for as Huston (1966:669) pointed out: "... as long as military operations are governed by the finite, some phase of logistics is bound to be a limiting factor." For a short warning/lead time the need is for readiness, i.e. people (soldiers, sailors, marines and airmen), materials and/or items must be readily available, therefore the Just-in-Case (JIC) convenience strategy should prevail. In this scenario the emphasis is on what is available after subtracting the committed people and materials/stock, i.e. it is the surplus to the committed or allocated people and materials/stock that is readily available for this call-off type. In contrast, where the warning/reaction/lead time is long, a Just-In-Time (JIT) system can be operated. This allows for crisis resupply and can incorporate established and proven industrial

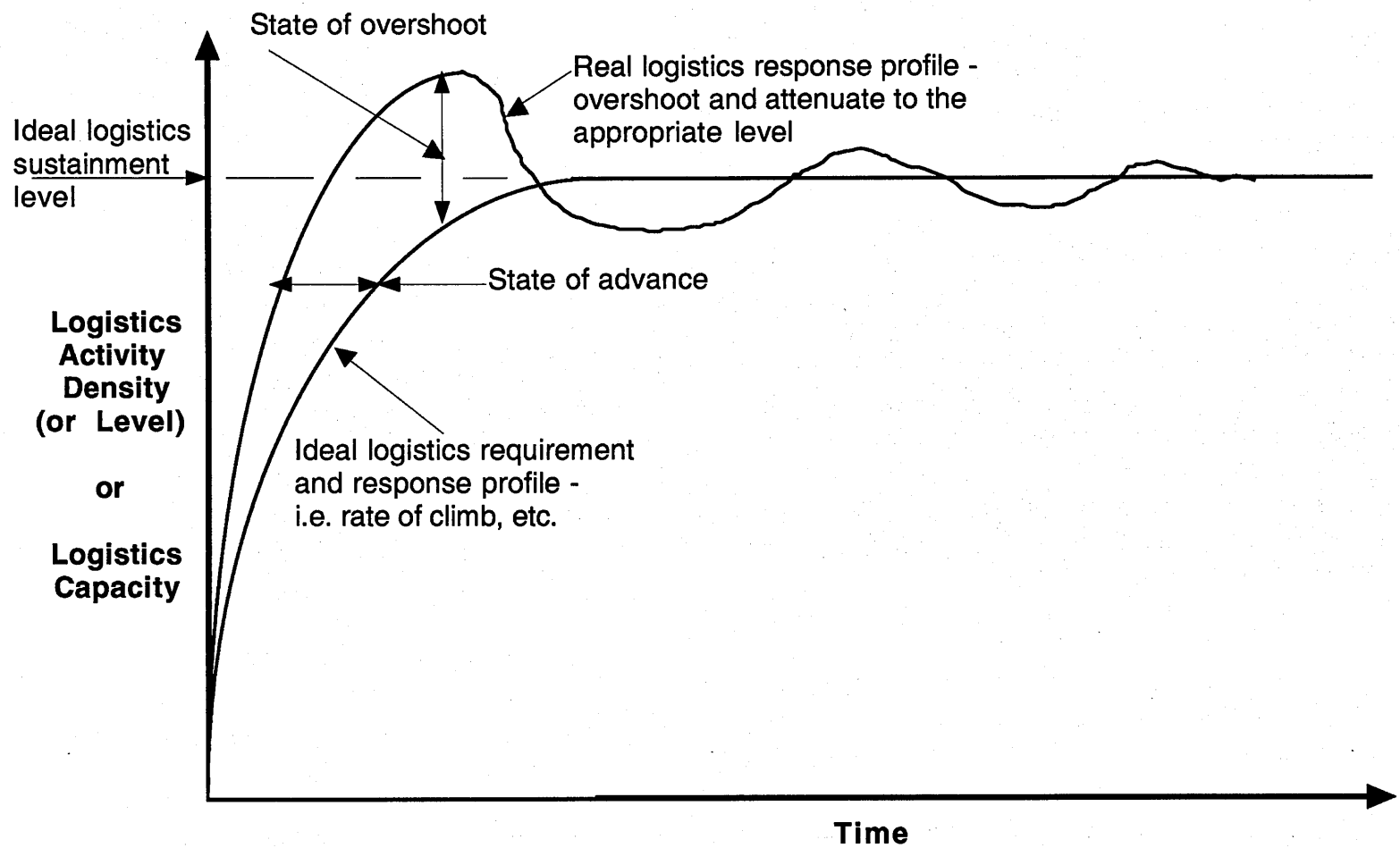


Figure 7.3 Theoretical Logistics Overshoot Response and Attenuation to Appropriate Level

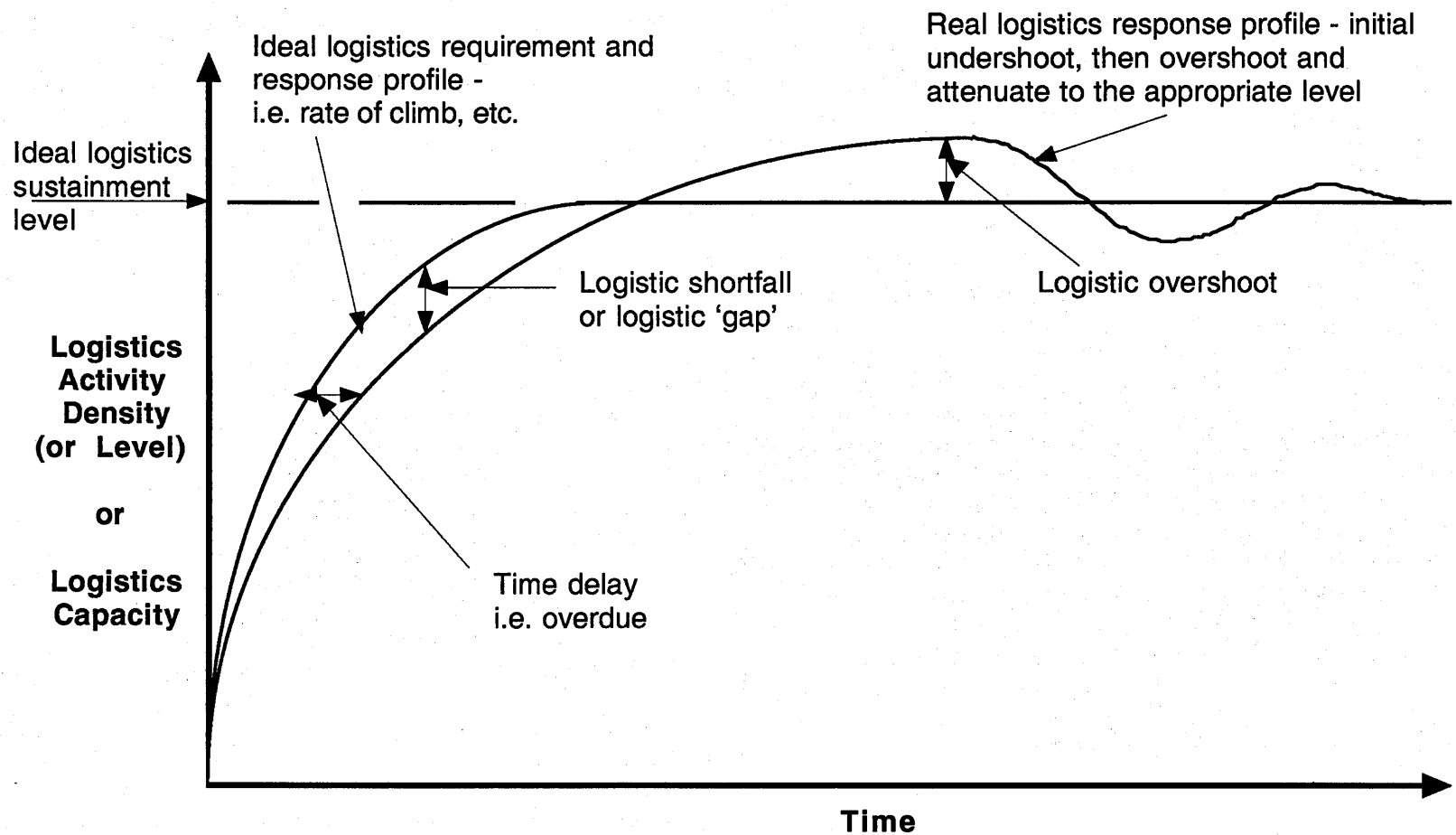


Figure 7.4 Theoretical Logistics Initial Undershoot, Then Overshoot Response and Attenuation to the Appropriate Level

Warning/Reaction or Lead Time:	SHORT	MEDIUM	LONG
Need:	Just-In-Case (JIC)/Ready (Availability minus Committed)		Just-In-Time (JIT)/Crisis Resupply and Industrial Supply Procedures
Rate of Change:	Fast (Throughput/Velocity of Existing)		Slow (Tailored/Designed Procurement/Supply)
Variability:	High (Stockpile)		Low (Stretch)
Protraction:	Long (Endurance; Structures/Roulement; Robust Infrastructure)		Short (Quick Fixes; Capitalise on Resilience; Stretch/Utilise Stock)

Table 7.4 Analysis of Some Variables With Time Dependencies

procurement procedures as a provisioning methodology.

A short warning/reaction/lead time calls for a fast rate of change in throughput capacity or an increase in the material flow velocity (compared to the existing norm) in order to meet the call-off demands. For long warning/lead times the rate of change can be slowed down. This means that a tailored (i.e. customised) or designed procurement and supply system could be inaugurated to match. For the Gulf War Menarchik (1993:172) observed: "Logistics set the timing for the war more than any other factor."

A short warning/reaction/lead time is usually the case when variability is high and a method to respond appropriately is to stockpile. In the long warning/reaction/lead time case variability is normally low and the ability to 'stretch' the normal supplies and procedures does not cause too much pain. For long duration, (i.e. protracted) campaigns/projects and operations a short warning/lead time calls for endurance with defined structures, the proper infrastructures and procedural *modus operandi* like a well organised 'roulement', particularly for the supply and recycling of spare parts and the evacuation of the wounded/injured and sick. The roulement for soldiers too can be necessary where the concentration and/or maximum restraint under difficult conditions (like in Northern Ireland) are called upon. The protracted case coupled with a long warning/lead time occurrence requires quick fixes, a need to capitalise on resilience and the nous to stretch resources/materials/stock and optimise their utilisation.

Continuing with the military theme, Table 7.5 examines the interrelationship between some of the variables and the types of logistics. In the single supply line (an umbilical cord) context, delivery lead time for goods is the time window that governs. Space is fixed (or limited to a radial distance confined within the supply capabilities), usually that of a marshalling area (equivalent to a main/national distribution centre), to which troops are linked for their supplies. Quantities are delivered in bulk via main supply route(s) (MSRs) and stored in bulk albeit dispersed over horizontal space. Localised buffer stocks can be held in Divisional Supply Areas (DSA) or Immediate Replenishment Groups (IRGs) thus maintaining a quality of supply because of the formal structures that are in place.

In the case of pre-positioning (or dumping), time is delayed because of constant returns to the fixed site for replenishments. The quantity/amount matter/issue is the amount that is predetermined between the parties involved and is dependent on the mission in hand. As a result of the fixed space that such a magazine outlines, there is a quality debit in the drag that results and thus impedes flexibility and mobility, and possibly hinders range and reach.

A pipeline supply constrains time to the running time, which is a factor of the flow velocity (capacity) of the pipe bore coupled with pressure and pumping limits. Space is

Variable / Logistics Type	TIME	SPACE	QUANTITY	QUALITY
Single Umbilical Cord	Delivery Lead Time	Fixed Marshalling Area (Main Distribution Centre)	Bulk?	Localised Buffer Stock (Area Distribution Centre)
Strategically Placed Magazines; Pre-Positioning; or Dumping	Delay	Fixes	Amount?	"Drag" (Mobility/Flexibility)
Pipeline	Running-Time	Fixed	Capacity Flow Velocity/Rate	Consistency
Self-Sufficient	Slow-Down OR "Short, Sharp Burst"	Freedom	Limited 'No Insurance'	Spatiotemporal and Mobility Equilibrium by Choice

Table 7.5 Comparison of Variables Governed by Types of Military Logistics

fixed at the pipe delivery head. Consistency of the product is a quality component of the pipeline logistics type.

In self-sufficient logistics, time is generally slowed-down as mobility is: impaired because everything that is required must be carried; or, improved for a 'short, sharp burst' if the accoutrements could be hidden/left somewhere for that 'short' period. This 'short, sharp burst' tactic was one of the ruses used by the Boers on commando during the Boer War of 1899-1902. (Reinhold Messner, the Italian climber, uses this 'short, sharp burst' - i.e. speed of execution - approach for his final assaults during his mountaineering expeditions (see Bleeke, 1989:19).) A benefit derived is the freedom of space (and/or spatiotemporal) advantage. The 'baggage carrying', naturally, limits what weight is possible and therefore, no 'insurance' can be guaranteed for the safe outcome or success of the mission. However, a quality determinant is the equilibrium that can be established amongst all the variables/factors (space/time/mobility) ensuing in any given situation.

7.5 Efficiency And Effectiveness

Put simply, efficiency is '*doing things right*', whereas effectiveness is '*doing the right thing*'. Effectiveness is vitally important to any organisation. The determination of how effective an organisation is in performing can provide useful feedback. The information can assist management in determining strategies and policies; it can also be used for staff motivation and serve as a source of information for other stakeholders. Any organisation's effectiveness depends upon the *balance* between *what is desired* and *what is achieved*, thereby instituting a 'gap analysis'. In times of economic recession or stress/hardship, many organisations look inwards (i.e. a cost reduction focus), devoting energies to discarding unprofitable functions normally using (possibly improperly analysed) techniques like: cost cutting; downsizing; and outsourcing measures. In such cases the energies are focused upon efficiencies, the *relationship between inputs and outputs*, rather than on effectiveness, which is concerned with the organisation's attainment of its goals. See Table 7.6 for a simple efficiency guide to inputs and outputs.

Leanness/Productivity Effectiveness Strategy	Working Efficiently	Working Smarter	Managing Growth	Cost Reduction	Paring Down
Input/Output Change For Greater RoCE, Productivity And Efficiency	Increase Output; Decrease Input	Increase Output; Maintain Input	Increase Output; Increase Input	Maintain Output; Decrease Input	Decrease Output; Decrease Input

(RoCE = Return on Capital Employed)

Table 7.6 Range of Appropriate Strategies

Outsourcing releases an organisation from the burden of keeping up with expensive, complex, and risky non-core activities (be they processes, situations, technologies, etc.), by assigning such tasks to an outside expert - thus ensuring access to the most advanced method/manner by which it could/can be conducted at a fraction of the cost, usually (see Quinn and Hilmer (1994)). Successful outsourcing requires a clear understanding of business objectives as well as the tasks and processes that deliver them (Quinn and Hilmer, 1994:48) - it therefore provides a substantial challenge for any outsourcing vendor serving multiple industries. The recent debate (particularly within the military) over outsourcing of logistics activities (like: purchasing; transportation; warehouse operations; sortation centres and cross-docking) in supply (and support) chain/network management is a good example of this; Foxton (1994:151-156) outlines the pros and cons of outsourcing for the military at each Line (i.e. level). Not all the military, or politicians, are in favour of contracting out military logistics tasks to civilian enterprises, see Extracts 7.1 and 7.2. While efficiency is essentially introspective, effectiveness highlights the links between the organisation and its environment. Since organisations have multiple, and sometimes conflicting, goals, effectiveness cannot be assessed by a single indicator. High achievement in one goal may mean low achievement in another. The full assessment of effectiveness should take into account several goals simultaneously.

In essence, the whole issue of effectiveness in organisations is concerned with (Fayol, 1949:3-6) planning, organising, leading (and/or directing/commanding), coordinating and controlling; using Forrester's (1961:vii) description: "The goal is "enterprise design" to create more successful management policies and organizational structures." An organisation's effectiveness is logically linked to its ability to achieve direction. It achieves direction through establishing goals and plans, using strategic (and properly analysed) management tools, recognising the importance of innovation and change, and establishing effective decision making mechanisms. Equally important is the right organisation, using a designed structure with coherent human resources policies. An effective organisation is driven through motivation from committed and visionary leadership, and clear communication using appropriate management techniques. Finally, control is important. Successful and effective organisations control their operations using well established and meaningful information and feedback systems. Rather than trying to cut costs in supply chain/network management by outsourcing (as some anecdotal evidence exists which disparages outsourcing) or other efficiency initiatives, a look at effectiveness first might reveal some interesting opportunities. This treatise is not an attempt to discard the concentration on 'core skills' argument (afterall see Magretta (1998:109) for some of the benefits); but a plea for proper analysis and consideration of all possible options, so that rational/appropriate/informed decisions can be taken/made.

Army fears moves to privatise supply lines

By Tim Butcher, Defence Correspondent

HUNDREDS of Army jobs, including engineers, drivers and suppliers, are under threat from Ministry of Defence proposals to use civilian firms to support overseas operations.

Traditionalists are horrified by the plans because they reverse accepted military wisdom that expeditionary forces should be fully self-sufficient.

An MoD spokesman said the proposals would "allow the soldiers to do what they do best and contractors to do what they do best".

But Field Marshal Lord Carver, the former Chief of the Defence Staff, said he was "totally opposed" to the plans currently circulating in the MoD to provide what is known as Expeditionary Campaign Infrastructure.

Bruce George, chairman of the defence select committee, said he would be writing to the ministry to ask for details of ECI but he said it appeared "to be another example of creeping use of the private sector in what hitherto has been sacrosanct for the public sector".

The proposals are not just to provide equipment but also services traditionally carried out by troops, such as perimeter protection, cooking, water purification and electrical power generation.

"I think this is a bad idea and I am totally opposed to it," Lord Carver said.

"One of the main lessons of the Crimean War and, indeed, the Boer War was the tremendous disadvantage of relying on civilian organisations for such things as the hiring of transport.

"If an expeditionary force finds itself in a situation developing into proper fighting then you will have problems with civilians.

"Sappers are not just engineers but soldiers as well so, if needs be, they can pick up a rifle and get on with it."

Supporters claim the scheme will not cost existing Army jobs, although this depends on which services are handed to civilians.

The plans have not been widely discussed in public but a number of companies are known to be preparing bids for the eventual contract, likely to be worth hundreds of millions of pounds.

A less ambitious prototype contract was signed in 1995 to provide facilities for 4,500 troops in Bosnia and it was worth £30 million.

Under the new scheme civilian contractors would have to provide everything to support a force of 16,500 troops in temperate climates, according to the latest edition of the MoD Contracts Bulletin, which refers to ECI in its section on "possible future purchases".

"ECI will collectively provide all the facilities and services that can be expected to accommodate a large body of troops," it says.

This will cause particular worry in the Army. Senior officers would be delighted with new equipment to replace, for example, the outdated stock of tents. But they would be less comfortable

Continued on Page 2

(Source: *The Daily Telegraph*, Tuesday, May 5th 1988, pp 1-2

Extract: 7.1 Contracted Civilian Supply to the Military

Army plan

Continued from Page 1

with the idea that "services" provided by military personnel would be contracted to civilians.

One of the military success stories in Bosnia was the British experience where enough Army engineers, drivers and back-up staff were deployed to support the front line troops.

If British troops were cut off, for example, by bad weather on the mountain roads they could call on Royal Engineers to deal with the problem.

The troops of other nations deployed to Bosnia had less adequate support and encountered significant problems with resupply and support.

The other significant issue is the extent to which the civilian workers would become involved in fighting.

One option being considered for ECI is to make civilian contractors working with the Army "sponsored reservists" whereby in times of conflict they would be treated like soldiers.

This is likely to be fraught with legal problems if such civilian workers refused to carry out a military order. The legal authority of a court martial would be complicated.

All of these issues are being considered by MoD planners. Industry has been asked to provide expressions of interest before August.

Mr George, Labour MP for Walsall South, said the defence select committee would want to consider the proposals for ECI. "There is the view now that the way to get more bang for your buck is to rely more and more on the civilian sector."

Red Berets are grounded by parachute shortage

by ANDREW GILLIGAN
Defence Correspondent

THE Parachute Regiment has been forced to cancel exercises and training because it does not have enough parachutes.

A Ministry of Defence spokesman admitted last night that the recently privatised packing operation for the parachutes had "fallen behind", resulting in "shortages of availability" for several units.

Urgent discussions are underway to solve the problem, but the MoD insisted that the Paras could still meet all their operational commitments.

One Para officer said: "At the moment we are getting roughly a third of what we should be getting. Basic parachute courses have had to be cancelled, a lot of units have lost their continuation parachute training and some are struggling to achieve their tactical training.

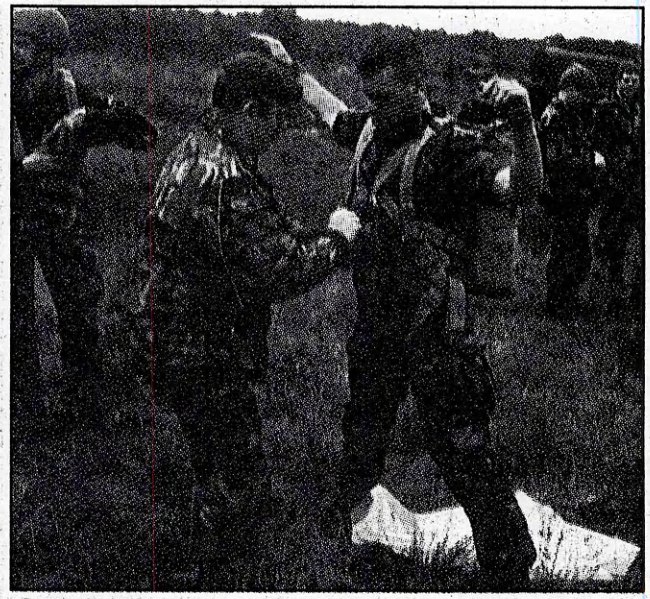
"Every airborne soldier is required to make four descents a year to remain current. But this year, some units will be lucky to get one."

Units are experiencing varying degrees of difficulty, with the worst problems found in the two Territorial Army Para batallions, one of which, 10 Para, is facing disruption to its main exercise of the year. Senior regular officers, however, confirmed that the shortage was a problem across the Parachute Regiment.

Each time a parachute is opened for a jump, it must be repacked by specialists before it can be used again. Until three years ago this work was carried out by servicemen at Hullavington in Wiltshire, but it was then handed over to a private company, Irvin Aerospace, which also makes the parachutes.

"Irvin's aren't employing enough people to pack the parachutes," another Para officer said. "They worked out the average demand and put their capacity on-line to meet that. But this year demand has been higher than the average."

Irvin Aerospace, based in Letchworth, Herts, refused to comment, but an MoD spokesman said: "We are in discussion at the moment with the company over a series of 'get well' measures.



Grounded: the shortage disrupted a big exercise by 10 Para

We are looking at various responses to get back onto a normal footing, such as recruitment of more packers and extra overtime. We hope to have the problems resolved before Christmas."

The MoD insisted that any shortages were "not critical" and that operational capability had not been affected. Brigade-level exercises, the largest regularly undertaken by the Paras, had all gone as planned and a jump into Albania last month during a Nato exercise had also taken place.

The three regular Para batallions are being forced to abandon many company-level exercises and so-called "continuation training" — refresher jumps for individual soldiers. Some large exercises are also being scaled down.

"Some units have called off planned jumps for reasons best known to themselves," the ministry spokesman said. "There is an impression at unit level that it's because of the parachute shortage but that is not the case."

But one Para officer said: "If I had mucked up like this, I would have been severely reprimanded. There has been a lot of shrugging of shoulders. No one has said that you have got to get this sorted out."

The shortages began to be felt in the spring, when demand for parachute training increases because of improving weather conditions.

The problem has been exacerbated by the withdrawal from service of the Army's old "PX" parachute in favour of the "LLP" or low-level parachute. Until last year, units without enough LLPs could practice on the PX, but that option is no longer available to them.

(Source: *The Sunday Telegraph*, September, 6th 1998, pp 9

Extract: 7.2 Outsourced Parachute Repacking

7.6 Summary

The principal dimensions and their derivatives have been described with examples and descriptions of the logistics relevance including benchmarking. Branching out from the dimensions, a treatise of the pertinent variables was explained together with the concepts involved and their meanings. Taking the military context particularly, an analysis of the interrelationships and inter-dependencies of time with the variables of need, rate of change, variability and protraction was tabulated and discussed. Finally, a simple display of the different military logistics types was made together with the subsequent derived governance of the variables of time, space (and/or spatiotemporal), quantity and quality along with an illustration of their significance. The understanding of associated dimensions, variables and their logistics' inter-dependencies enables better and penetrating questions to be asked at research interviews and in research case studies, thus allowing better explanations/descriptions/analyses, in-depth comprehension and transference of found knowledge. For enterprises/organisations, the understanding of logistics' variables can/may aid in the decisions associated with whether to go/move to 'strategic outsourcing' of various logistics and/or service functions, or to retain them in-house?

There is no doubt that the UK military will have to perform (and so will its suppliers and service providers) to what the government call "Best Value" (BV). *Best Value* is a statutory duty, which the British government proposes to place on Local Authorities (including Police Authorities and the Military) from April 2000, to deliver services to clear standards - covering both cost and quality - by the most effective, economic and efficient means available.

By considering the *duration of a war* versus *demand pattern* as variables, it becomes possible to categorise 'types of war/battle/conflict' and hence 'types of logistics'. The ramifications for logistics in each war *category* can then be evaluated; this follows in the next chapter where the principal hypothesis for the research is generated as an outcome from all the preceding studies.

8. GATTORNA'S SYSTEMS APPROACH AND TYPES OF LOGISTICS

"The more original a discovery, the more obvious it seems afterwards."
Arthur Koestler (1905-1983)

From all the above learning and literal experiences in both sectors, and by using a sytematic approach/analysis to understand the generated demand patterns of military and commerce, and then relating these to time (or durations), allowed a 'types of logistics' model formulation to be developed in this chapter - forming an hypothesis that can be *tested* with/via an appropriate research design.

8.1 Gattorna's Systems Procedure

In his lecture, Gattorna (1994) posed four aspects as being the 'big issues' in logistics, viz:-

1. Network Shape (How many distribution centres? Where should their location be? What is/are their role(s)?) See Table 8.1 for a 'nodes and links' checklist.
2. Distribution Channels (What is/are the best value path(s) to customers?)
3. 3rd. Parties (One or many? Where are they appropriate?)
4. Changes to the status quo (How to manage: merged networks; and entry into new markets?)

NODES	LINKS
Purpose Location(s) Size Number	Purpose Capacity Length Availability and Frequency of Link Capacity Number and Type(s)

Table 8.1 Logistics Network Shape 'Nodes & Links' Checklist

The level of complexity was hailed as being the constraint on making effective decisions and a contributory factor in making piecemeal decisions that do not take account of interdependency. Gattorna (1994) warned of one-off 'fixes' that have repercussions elsewhere; here, again is the 'avoid the sub-optimisation' argument. The resolution of complex logistics issues could be achieved by focusing on (Gattorna, 1994):-

1. The "System"[37] involved (recognising the sub-systems), and

[37] Definition of a System: a group or combinations of interrelated, interdependent, or interacting elements forming a collective entity; a methodical or coordinated assemblage of parts, facts, etc.

2. The natural forces driving the system patterns exhibited by the system are the evidence of how the system responds to these natural forces.

In his 'systems approach' to quantum logistics improvement, Gattorna (1994) advocated:-

(a) Look for the natural patterns and understand the systems that create these patterns, viz: the market place; buying logics; etc.
(b) Define the detail of the system that respond to these patterns, viz: distribution channels; the logistics network; etc.
(c) Optimise the operation of this system, viz: optimisation modelling; etc.
(d) Measure the appropriateness of the output of this system (service and cost) and adjust, viz: customer satisfaction indices; etc.
(e) Compare (d) with (a) and fine tune.

Gattorna and Walters (1996:131-132) argued that there are three basic demand flow patterns which occur frequently. They are: *base flow*, which is a steady state high level of demand/consumption where very little variability manifests and is therefore very predictable; *wave or cyclical flow*, where high and low demands manifest in phases - like seasonality, where the peaks are relatively predictable; and *surge flow*, where demands are generally unpredictable and erratic. The *surge flow* category is sub-divided into two types: type (1) consisting of high criticality, low value, long lead time and small physical size; and type (2) which consists of low criticality, high value, bulky physical characteristics and peaks which are relatively predictable. Compatible stockholding policies were advocated for each type. Gattorna (1994) imparted the view that a single type of logistics system is not capable of handling every type of demand. The inference here is that a logistics system should be 'tailored' to respond to a certain demand pattern with a predetermined designed service level (or within a specified range of service levels/capabilities). The concept, coupled with examples, of *tailored logistics* was advocated and reported by Fuller et al (1993). According to Gattorna and Walters (1996:27-29) the 'tailoring' is achieved via analysing the *alignment logics* and subsequently producing a strategic fit through the alignment (Gattorna and Walters, 1996:39-42). The author has discovered that research into surge management for/by the military would be both worthwhile, and welcomed, by defence personnel, as this is an area that they would *like to understand* better.

8.2 Types Of Military Logistics

In an attempt to aid understanding, an analysis of 'types of war' was conducted, followed by the development of a military 'types of logistics' framework superimposed onto a comparable commercial logistics template.

8.2.1 Types Of War

War is a protean activity; it changes form, often unpredictably. War is collective killing and/or destruction for some collective purpose. WW2 culminated in the deployment of a weapon designed to rob collective killing of any logical purpose. The nuclear bomb/weapon did, indeed, seem a final antidote and has proved a homoepathetic antidote itself. But it has not proved an antidote against the use of other weapons. During any war or conflict nowadays, the factories/plants and manufacturing capabilities, and production capacities for weapons making/construction owned by, or belonging to, an enemy, are legitimate targets for the opposing force(s). It is because of this fact that many nations choose to stockpile weapons, ammunitions and fuel(s) substantially (usually in many storage locations). This stockpiling strategy enables a short response time and decouples the action from the dependence of productive ties - initially at least. Therefore, an outline of the uses and limitations of fighting a war with stockpiles (i.e. inventories only) is worth analysing.

A short war is fought with stocks/inventory only, and any destruction of productive facilities by an enemy is relatively useless in influencing its outcome (Brodie, 1946:79; Walkowicz, 1955:121). The *maximum* time period a war *can* be fought with stocks alone depends exclusively on their level and on the rate of their utilisation/consumption, which varies of course for different items, being perhaps years for some items, and days for others. The *minimum* period in which a war *must* be fought with stocks only is the time lag between production of the end items and their actual use in war. Since the rate of utilisation/consumption of end items at the beginning of a war usually exceeds the rate at which they are being produced/turned out, there is a longer period in which either the war effort must be restricted while production increases, or reliance must be had on initial stocks; both the stocks and the reliance on them diminishing as production rises.

The *maximum* period in which war *must* be fought with stocks/inventory, (this is the case of zero initial production), is the time required for conversion and/or construction of productive facilities, plus the time required to produce the end items and deliver them to their user(s). In actuality, the initial reliance on stocks, and the decreasing reliance on stocks as production gradually increases, can be expressed at any period in the course of the war as a *ratio of current production over current consumption* of the end items (with a suitable lag for delivery from the plant, and from stocks, to the final users). The longer the expected duration of a war, and the more intensive it is expected to be, then the greater the importance of productive facilities relative to stocks as determinants of the war effort. A short war, defined as one fought with stocks/inventories alone, can be expressed in terms of time only if initial levels of stocks and utilisation are both known.

A war expected to last an intermediate period is fought both with stocks and with wartime produced output. The intermediate period is defined to be long enough to permit

existing facilities to attain their maximum rate of output and short enough to preclude large increases in production from major conversion of inessential facilities and investment/construction of additional facilities. In a war of this expected duration the capital equipment, labour skills and weapon types are assumed to remain unchanged (i.e. fixed). As this period becomes longer, the war effort is more and more limited by the level of production. The importance of stocks as a limiting factor depends entirely on their size relative to rate of consumption on one hand and of production on the other. Only as long as stocks/inventories are large in terms of consumption do they permit a greater effort than current production justifies.

A long war is one expected to last long enough to permit conversion of facilities and investment/construction in/of new facilities to the required productive level. There is no maximum which can be specified in general terms, since the longer the expected duration the slower can be the build-up process, although this need not take place. The minimum period compatible with the definition of a "long war" depends first upon the gap between the initial level of war production and the desired level; second, upon whether conversion or new construction is required to bridge the gap; and third, upon the resources which can be spared for expanding productive capacity. The other factor/variable appertaining to a long war is the introduction of new, technological advanced weapons, equipment and facilties which result from the *need*-stimulated intensive military related research and development (R&D).

8.2.1.1 Priorities

The expansion of war-waging capacity competes with the war production for manpower (particularly skilled manpower), for materials, and for plant and equipment. The allocation problem is simple in a short war fought exclusively with stocks, still relatively simple in an intermediate war fought with stocks and the production of fixed plant, but quite complicated in a war long enough to allow the choice between allocation of manpower and resources between war prosecution, war production, and the expansion of war production capacity. If the massive use of manpower and military end products in war can be deferred for some time, as was the case of the Western Allies in WW2 between Dunkerque and D-Day, then current production of end items can be held back for the sake of expanding capacity for future production, and the use of military end items can even be deferred until not only capacity has been raised, but stocks of items produced by this added capacity have been built up.

An examination of WW2 revealed a story of shifting emphasis in the US: priority on conversion and addition to munitions capacity in the early war period, shifted to output of war goods in the intermediate war period, then, with munitions employment declining by 1944, manpower was shifted to the military effort, with the armed forces reaching their maximum in mid-1945, well after reconversion of industry to civilian production was largely completed (Long, 1952:16ff). *These three successive stages/efforts could*

not have attained the same level had they been pursued simultaneously. For the US it was possible to space out these separate programmes and avoid, therefore, too serious a problem in allocation of scarce resources to competing ends. In the case of the USSR it was necessary to pursue these aims simultaneously - USSR resources were not adequate and had to be supplemented, in large measure, by American aid (Keegan, 1993:313).

8.2.2 Types Of Logistics

A construct[38] for 'types of logistics', with 'duration' and 'demand changeability' as principal variables, was conceived. The duration variable appeared an obvious one as the protracted nature of military campaigns can be 'taxing' and to end campaigns quickly could depend upon responsiveness in the short term. The demand changeability came from an interpretation of Van Creveld's (1977:182) theme: "By and large, the story of logistics is concerned with the gradual emancipation of armies from the need to depend on local supplies." In his view, Lynn (1994:10) commented: "Or another way to say it is that over time armies became more bound by supply lines that linked them with depots in the rear. He [Van Creveld] proposes an interpretation of the nature and timing of this process that differs from a kind of orthodoxy that has grown up among military historians. As is the case in so many debates between historians, the controversy comes down to a struggle between the two interpretive poles of change and continuity. In the case of logistics, the orthodox view stresses change and van Creveld stresses continuity."

Using Gattorna's (1994), and Gattorna and Walters (1996:24-46) systems approach of analysing natural patterns with which the military have to contend, led to the construction of a 'logistics type' matrix - or map - employing the variables of duration (the vertical axis or ordinate) versus the abscissa of demand changeability as described above. The resulting quadramorphic construct of alignment possibilities is shown in Figure 8.1. An explanation of the four quadrants follows now with respect to time, volume, variety, changeability and possible predictability/forecastability.

It should be noted that in *all* the military instances, supply from held stocks/inventory occurs first, and the degree of Industry use/involvement for replenishment subsequently depends on the duration of the wars/campaigns as delineated above. From Figure 8.1, the top right quadrant is composed of a protracted campaign (i.e. long duration) and a continuous demand/requirement of mostly known materials and quantities because of a known high intensity level (i.e. high volume and probably a known variety level). This constitutes war - i.e. full capability: where the logistical need is multiple umbilical cords, many supply lines including *local purchase(s)* (i.e. multiple

[38] A 'construct' is a word-symbol (or a diagrammatic/word-symbol/picture) for an idea and has a specific meaning. For example, inventory is a word-symbol for an idea and becomes a construct when defined as raw materials in storage, goods/work in progress, or/and finished goods in storage.

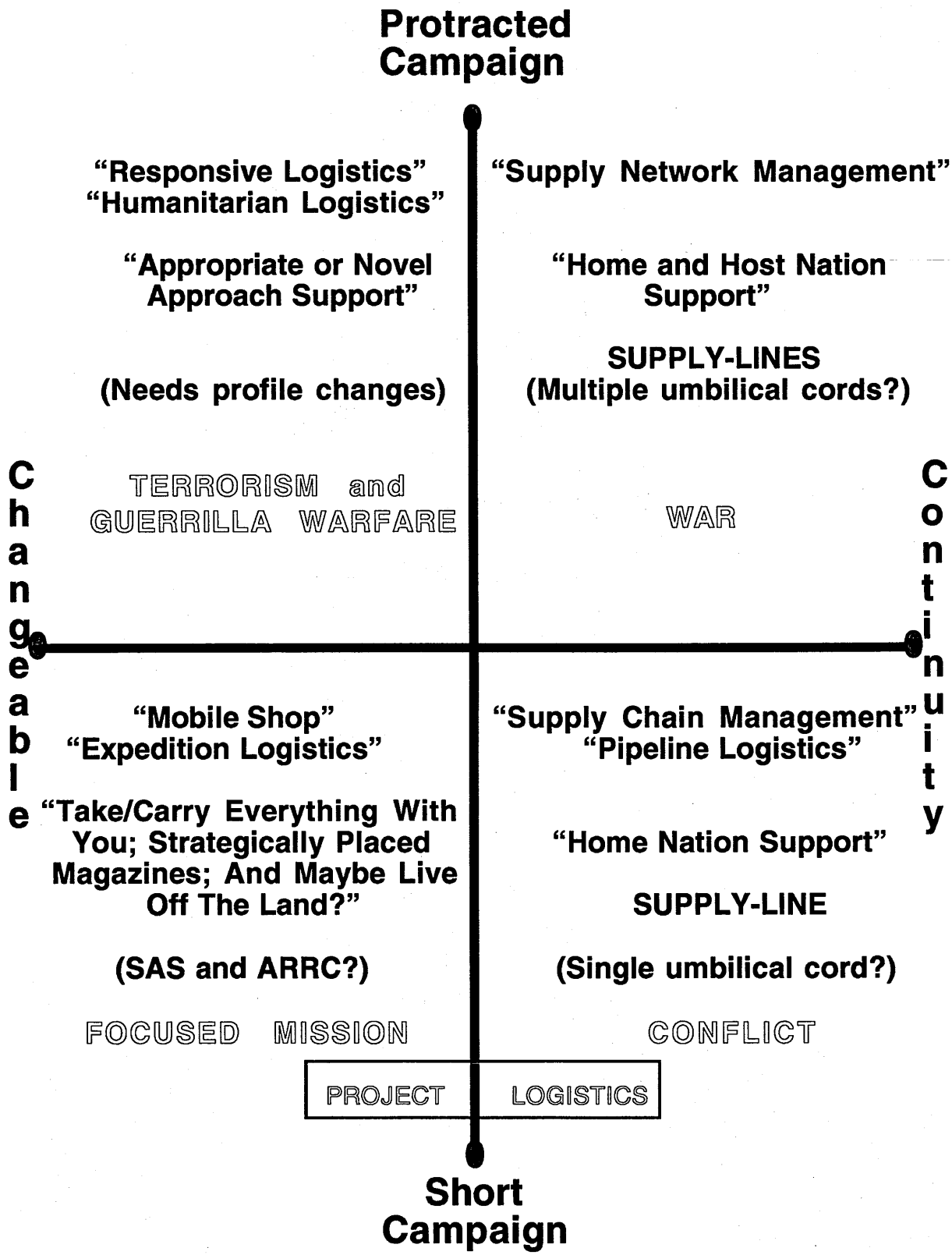


Figure 8.1 Four Types of Logistics and a Hypothesis

sources and multiple links resulting in a supply network) in the form of both home and host nation (and possibly other ally) support - i.e. *full capability* deployment. (A declared 'state of war' for the MoD means that all supplies can be issued (or taken) without the proper procedures (i.e. the *red-tape* can be by-passed) and accountable proof is not necessary (no other 'state of play' or 'conflict category' has this *privilege*); this is to eliminate delays by the removal of impeding processes and bureaucracy. A recent example portraying this state of affairs was in a National Audit Office (NAO) Report of December 1996 which informed the government (and the Army) of £9 million of ammunition that was unaccounted for and/or missing. The Army pointed out that the ammunition was not unaccounted for, or missing; the ammunition was in Bosnia. As the situation in Bosnia had moved to a 'different footing', the Army had instigated the 'state of war procedures' and thus the *red-tape* was by-passed/cut.) This quadrant aligns with the commercial equivalent of Supply Network Management - the ideal being 'spatial integration' with some 'outsourcing' - excluding the non-accountability aspects.

(The word/term *war* was chosen after much consideration. Whilst a definition of war was sought from NATO literature, none could be found. It is very probable that the word/term *war* is a politically unacceptable word/term to, and for, NATO. Many alternative phrases are used by NATO to describe countries/nations engaged in war, like: they *pose a threat to collective security*; they have *a policy of aggression*; and they have created *a conflict area*, etc. However, von Clausewitz (1843), based on the premise that war was an extention of/to politics gave a definition (in Howard and Paret (1977:75)): "War is an act of force to compel our enemy to do our will ..." Also, Howard (1979:1) offered the following: "War ... is ... a highly social activity - an activity indeed which demands from the groups which engage in it a unique intensity of societal organization and control. It involves the reciprocal use of organized force between two or more social groups, directed according to an overall plan or series of plans for the achievement of a political object." Another definition and qualification from Warden III (1997:229-230) was: "... war is the use of physical force, or the threat of its use, to change an environment, in the face of opposition, to something in consonance with our desires. This definition encompasses traditional wars, peacekeeping, and disaster relief. In each case we alter with physical means a system, or environment, that does not want to be altered or would not alter in the absence of outside intervention." The term 'War' in the top right quadrant of Figure 8.1 has been used as defined/described by Clausewitz, Howard and Warden III, particularly with regard to logistics - and its alignment - for sustainment of a party engaged in war, as in Howard's phrase: *"... a unique intensity of societal organization and control."*)

The bottom right quadrant is formed from a short campaign requiring continuous supply for its objectives (i.e. medium to high volume and probably a known variety level for a defined period). Choosing a descriptive term for this was, again, difficult, but the term chosen was "conflict" meaning a *limited scale* (although this has degrees)

operation. The logistical need for this is probably a single umbilical cord, a single supply line/strand from the home nation only, where there is a known (or forecasted) intensity level. This is a linear logistics scenario - a chain of single links - and is aligned with commercial Supply Chain Management (or Pipeline Logistics) - the ideal being 'channel integration' possibly coupled with some 'outsourcing'. Also, coming into this section/category is MACA (Military Aid to Civilian Authorities)[39] where the military are asked to provide and/or stand-in for, and take charge of, matters like Dustmen and/or Fire-Service strikes and disaster management like providing 'flood protection' from overflowing rivers and the consequences. That is the military conducts these civilian duties/tasks/services until the dispute(s)/conflict(s) or disaster(s) are resolved or over.

The bottom left quadrant is composed of a short campaign with changeable demands (probably low to medium volume and high variety). This is the focused mission carried out by Special Air Squadron (SAS), Special Boat Squadron (SBS), 'special operations' undertaken by the Special Operations Executive (SOE) in the UK and by the Office of Strategic Services (OSS) in the US, or a part of the Allied Rapid Reaction Corps (ARRC). The use of the ARRC here is for a small focused mission, (clearly if the total ARRC complement (i.e. 55 000 soldiers) was deployed the scenario would probably be war (i.e. top right quadrant) with the need for many supply lines and/or networks). Here, logistics is achieved by good, solid, advanced *pure planning*. An appropriate logistical approach in this case would require strategically placed magazines and the bulk of the regularly needed accoutrements having to be physically carried by the force members, or by a compatible car/van/lorry for the load and terrain. All military pilots, SAS/SBS soldiers, Royal Marines and Commandos are trained/educated in survival techniques/methods for the different environments and circumstances. The demand pattern is anticipated/forecasted and planned for, with a *balanced risk* calculated between: the carrying of necessary equipment and supplies, health and safety, and the ability to face/handle an array of 'likely' problems to be encountered with formulated 'exit plans' if necessary; with the need for flexibility, speed and/or mobility and, the mission's importance/criticality. A direct commercial parallel is probably the mobile shop (fish and chip vans; ice cream vans; van selling are other examples) which brings the offerings to the customers' locale. Expedition logistics (i.e. scaling mount Everest; journey to the South Pole) is a sporting or adventure analogy. Also, sports competitors at racing events (e.g. Formula One Car; Horse Racing; Show Jumping, etc.), trials, gymkhanas etc., who have to tow their machine or animal and the associated back-up to the event venue forms another parallel. Further examples are: the 'Travelling Theatre'; 'Pop Groups/Bands'; and/or a television 'Outside Broadcasting' unit; when they go on tour, all the equipment - instruments, scenery, etc. is transported together with the actors,

[39] Military Aid to the Civilian Administration (MACA) is composed of three pillars: Military Aid to the Civil Community (MACC) which attends to 'Acts of God' and disasters (including industrial kinds); Military Aid to the Civilian Powers (MACP) which deals with minimising any potential/forecasted risks and; Military Aid to the Civilian Ministry (MACM) which covers civil service 'strikes'.

band or group members. The key aspect of this quadrant is that a high degree of *self sufficiency* is sought and orchestrated, which may include some form of 'internal integration'.

The last quadrant, comprising of changeable demands and of a protracted nature is terrorism and guerilla (and/or anti-terrorism and anti-guerrilla) tactics/warfare which is totally unpredictable and unforecastable (i.e. volume fluctuations and high variety). A title/term used by the military here is: Military Aid to the Civilian Powers (MACP). The requirements profile here changes frequently and therefore an appropriate, special or novel logistical need would have to be designed to match the changing patterns/events. Whilst the pure logistical risks themselves here are probably minimal, the *specialist/specialised needs* may themselves create logistics problems. One possible case here involving industry and/or business/commerce would be the military's *immediate* need of/for something/equipment and the supplier (i.e. industry) *has to respond* instantly; the military have a system set-up for this and they refer to it as 'Crisis Resupply from Industry Procedures' (CRIPs). The commercial parallel is responsive logistics (or adaptive logistics) for fashionable/fad consumer products; and another close match is humanitarian logistics. Terms used by the military here, should they be involved/used in humanitarian logistics, are: Services Protected Evacuation (SPE); and Services Assisted Evacuation (SAE). Take humanitarian logistics: usually the first priority is to evacuate large numbers of people - mass transit; followed by some form of housing/shelter - tentage, warm clothing and blankets; food and water supplies are next to sustain the people; communications need to be set-up; usually an epidemic or outbreak of diseases occurs thus requiring medical supplies and doctors; the dead have to be buried or cremated; distribution of the refugees; etc., etc. It can be argued that if only a responsive logistics arrangement is set-up, it should, by definition, be able to cope with the other three quadrants for their initial demands and then it should be adjusted to the subsequent appropriate sustainment mode. In the commercial world this is Responsive Logistics (e.g. for fashion items or a sudden demand that was not predicted/forecasted) requiring some combination of leanness and agility; here again, this may include some form of 'internal integration' coupled with 'outsourcing'. A civilian need for this responsive logistics would be in the rescue, accident and emergency services area.

For the military, the lower half of the matrix in Figure 8.1 could be called, or classified as, 'project logistics', because they have a defined beginning and an end as well as being relatively unique. Whilst in the commercial sector this exists (i.e. like building an oil refinery or factory; the construction of a large sea port; etc.) it is much harder to locate them as a specific type of logistics in the matrix. Also, whilst promotions or specific limited sales of products exist in the business world and these are treated as projects, there is not a common type of logistics that would apply to all of them, but they are usually short-term in nature and can be unique. An example of a commercial short-term situation that the author was informed about is that when Diana,

Princess of Wales died in the car crash, the surge in demand for newspapers/magazines and other related increased demands caused the UK logistics service provider TNT to employ 300 extra lorries to cope with their clients' requests for the ensuing three to four weeks[40]. Expeditions, on the other hand, can (and do) come under the umbrella of 'project logistics' because they are usually unique and do have a specific beginning and an end. (The essence and pre-requisite for success in these lower half matrix classifications/tasks/jobs is good, pure, *professional planning*.) Therefore, because of the *slight* mismatch in the Supply Chain Management (Pipeline Logistics) quadrant, this comparative construct is not *totally* all embracing, but is a reasonable representation of comparative logistics genres.

Figure 8.1 provides an interesting hypothetical framework from which to spring-board from and, it allows discussions about supply positioning/alignment within the four types postulated. This construct - Figure 8.1 - forms the cardinal hypothesis for this thesis: the construct holds as a logistics category representation of logistic patterns within the military and commercial fields. It is in the area of responsive logistics that research work is required to provide commerce with a competitive advantage and the military with threat reduction (via deterrent) or strike advantage, hopefully at an acceptable cost.

8.2.2.1 Comment

Many authors have intimated the need/requirement for different distribution/supply chains/networks that are designed for purpose. Fuller et al (1993) alluded to this when they published their article titled: "Tailored Logistics: The Next Advantage", and so did Dvorak and van Paasschen (1996) with their article "Retail logistics: One size doesn't fit all", in which they concluded - about logistics systems - (Dvorak and van Paasschen, 1996:129): "Trying to create a system that could simultaneously support all strategies is almost impossible: ...". Indeed, Cox (1997:241-242) differentiated supply chains into *process-based* and *project-based* classes with these definitions:-

- Process-based supply chains have a process of regular transactions, delivering standardised products or services, through a relatively permanent structure.
- Project-based supply chains have a process of irregular and infrequent transactions, delivering non-standardised products or services, through a relatively ad hoc structure.

Fisher (1997:107) also differentiated supply chains into *Functional* (predictable demand) and *Innovative* (unpredictable demand) types. Taking this separation further, Fisher (1997:108) tabulated the properties/characteristics of the two supply chain types, showing one to be a physically efficient process, and the other to be a market-responsive process; Table 8.2 is a reproduction of his tabulation. A further view by Sanchez (1996), enunciated from his strategic product creation investigation (Sanchez, 1996:123-125), stated that:-

[40] Alan Jones - Managing Director of TNT - informed the author about this surge in required resources.

	Physical Efficient Process	Market-Responsive Process
Primary purpose	supply predictable demand efficiently at the least possible cost	respond quickly to unpredictable demand in order to minimise stockouts, forced markdowns, and obsolete inventory
Manufacturing purpose	maintain high average utilisation rate	deploy excess buffer capacity
Inventory strategy	generate high turns and minimise inventory throughout the chain	deploy significant buffer stocks of parts or finished goods
Lead-time focus	shorten lead time as long as it doesn't increase cost	invest aggressively in ways to reduce lead time
Approach to choosing suppliers	select primarily for cost and quality	select primarily for speed, flexibility, and quality
Product - design strategy	maximise performance and minimise cost	use modular design in order to postpone product differentiation for as long as possible

Adapted from: Fisher (1997:108)

Table 8.2 Physically Efficient Versus Market-Responsive Supply Chains

For a company that followed, or possessed, a 'product strategy emphasis' then:

in a product market with '*stable* technologies and market preferences' it would focus on increasing market share by reducing costs for producing standard products and by extending control of distribution channels; whereas
in a product market with '*evolving* technologies and market preferences' re-design of the distribution channel would/may be required to better match the changes in product offerings; and

in a product market with '*dynamic* technologies and market preferences' flexible distribution networks would be required - probably these would be achieved by the company networking with other companies (e.g. arrangements, partnerships, alliances, etc.) to improve their abilities to assemble a changing array of resource chains for creating and delivering future new products which cannot presently be defined with precision.

Furthermore, from her interview with Victor Fung, Magretta (1998:109) recorded: "Just about every company I know says that they are customer focused. What, in fact, does that mean? Usually it means they design key systems that fit most of their customers, they hope, most of the time. Here we say - and do - something different: We organize for the customer. ... Our basic operating unit is the division. Whenever possible, we will focus an entire division on serving one customer. We may serve smaller customers through a division structured around a group of customers with similar needs. ... This structuring of the organization around customers is very important - remember that what we do is close to creating a customized value chain for every customer order."

It is now possible to seek an appropriate research design and methodology for verifying/corroborating or refuting the hypothetical construct (Figure 8.1) described above; this is what follows next in Chapter 9.

9. RESEARCH DESIGN, QUESTIONS AND METHODOLOGY

"There are three parts in truth: first, the inquiry, which is the wooing of it; secondly, the knowledge of it, which is the presence of it; and thirdly, the belief, which is the enjoyment of it."

Sir Francis Bacon (1561-1626)

9.1 Introduction

The methodology chosen to conduct a piece of research plays a pivotal role in the research gaining both credence and acceptance by the respected experts and critics within the topic's community. For instance, in a positivistic approach, the degree of proof required to consider the hypothesis proven is a factor in selecting the most suitable research methodology. For a study, research method suitability will support validity and reliability of data from which conclusions and possibly theories can be shown to be drawn. The choice of an 'appropriate' specific research approach contributes credence, logic, respectability and replicability (if necessary) of the research outcome(s). Yin (1994:4-9) advocated the full understanding of three conditions for choosing/selecting an appropriate research method/strategy, he cited:-

(a) "the type of research question posed (i.e. what, who, where, why, how, how many, and how much?)";

(b) "the extent of control an investigator has over actual behavioral events"; and

(c) "the degree of focus on contemporary as opposed to historical events".

The research strategy options consist of five types:- experiment; survey; archival analysis; history; and case study.

Primarily, whilst research is about discovery, according to Dane (1990:5), the immediate goals of research are: exploration, description, prediction, explanation and action. These five goals provide a strategy for considering which questions to ask and which answers to seek. Research goals affect the methods used to conduct a research project, and they affect the ways in which that research could be evaluated. Within any significant research study, the research design, methodology and procedures are likely to be amongst the most critically evaluated aspects of the investigation and, therefore, warrant important attention to detail and selection for suitability and compatibility with the research aims.

Research design constitutes an action plan - a statement of intent - that logically links the empirical data to the project's initial research question(s) via methodology and, finally, to its results. In parallel with the research design runs the epistemological philosophy and the philosophical doctrine (or position) that underpins and underlines the whole methodology.

Epistemology is the philosophical theory (the investigation of the possibility, types,

and sources) of knowledge: What is it? Can we have any? Are there different kinds? How are they justified? Basically, how do we know what we know? These are often taken to be the central questions of philosophy. Most philosophers think that knowledge involves beliefs that are true and justified; many claim in addition that the beliefs must be produced in the right way. *Sceptics* argue either that we can have no knowledge at all or considerably less than might be thought, usually citing lack of justification. *Foundationalists* require that if a belief is justified it must be directly immune from scepticism, or derived from such beliefs by immune inferential processes. *Coherence* theorists claim instead that beliefs need only 'hang together' to be justified. *Empiricists* claim that all non-trivial knowledge is *a posteriori*, derived from experience. *Rationalists* disagree, claiming that some - if not all - significant knowledge is *a priori*, independent of experience.

Ontology deals with 'the nature of being' metaphysically (i.e. 'after' or 'beyond' physics) and has a role within research, via interpretation (i.e. hermeneutics which is conceived most generally as the study of the interpretation of such meaning-laden phenomena as language, works of art, and social practices) and inference, as it investigates what sorts of things exist most fundamentally and how they are related. For example, a materialist ontology claims that matter is the only fundamentally existing thing, so that anything else alleged to exist must either not really exist or be accounted for in exclusively materialistic terms. *Monists* claim that only one sort of thing really exists; some monists are materialists, others are idealists. *Pluralists* claim that two or more sorts of things ultimately exist; the most familiar variety is a dualism of matter and mind.

The whole research process also encompasses a philosophical doctrine (or position) of which there are many; some of them are described below:-
Positivism: this maintains that all genuine knowledge is acquired by science, and denies the validity of metaphysical speculation.
Realism: maintains that whatever exists has its character independently of its being perceived by human or divine minds and is opposed to verificationism and some versions of idealism and phenomenalism. (Blakie (1993:59) described realism as the search for underlying *'generative mechanism(s)'* and *critical realism* comes via three stages, viz: empirical - action observed; actual - action is taken; and real - caused to happen.)
Empiricism: maintains that all or most significant knowledge is based on sense experience; it is usually contrasted with rationalism.
Verificationism: a philosophical position, held by logical positivists, which claims that synthetic propositions are meaningful only if their truth or falsity can be determined, in principle, by empirical observation (e.g. 'The number of stars in the universe is even'). Verificationists typically assert that propositions such as 'God exists' and 'Murder is wrong' are meaningless.
Rationalism: maintains that knowledge is independent of sense experience; it is usually contrasted with empiricism. Rationalists generally hold the belief that science is a

deductive system, reflecting the fact that there is no contingency in nature. The axioms are ideas within us innately and a cause must be adequate to its effect.
Relativism: this is any philosophical position which maintains that there are truths and values, but denies that they are absolute. Epistemological relativism asserts that all truth is necessarily relative; 'is true' is always elliptical (i.e. very concise, often so as to be obscure or ambiguous) for 'is true for *x*', where *x* might be an individual, society, or conceptual framework (i.e. the idea can apply to any person/body/organisation/case).
Interpretivism maintains that theories and concepts tend to arise from an enquiry; they come after data collection rather than before it. So, because of this, it is often referred to as 'hypothesis generating' (when compared to 'hypothesis testing') research. Many interpretivists take the position that there is no "fact of the matter" and suggest by extension that it is not really possible to specify criteria for good qualitative work - and that the effort to do so is somehow expert-centred and exclusionary, not responsive to the contingent, contextual, personally interpretive nature of any qualitative study.
Phenomenalism: this maintains that physical objects are just collections of sense data lodged in individual minds. Since it implies that objects cease to exist when unperceived, some phenomenalists, such as Alfred Jules Ayer (1910-1989), have recast the doctrine so that propositions about objects can be translated into propositions about actual or hypothetical experiences. (*Phenomenology* means analysing human experience in terms of its own internal principles and structures, instead of using some external frame of reference. A phenomenological analysis takes experience on its own terms, and tries to understand how it operates as a system of meanings for those who have had the experience.)
Idealism: the metaphysical thesis that the only things which really exist are minds and their contents. George Berkeley (1685-1753) maintained that 'to be is to be perceived or a perceiver'; physical objects are collections of ideas that exist only insofar as they are perceived by finite, human minds or by the infinite mind, God.
Conventionalism is a doctrine which maintains that scientific theories (or parts thereof) are not confirmed by evidence, but are the product of linguistic stipulation. For example, a conventionalist might claim that in Newtonian physics, no evidence counts for or against the proposition that force is the product of mass and acceleration; 'force' is simply defined that way.

9.2 The Research Design

9.2.1 Hypotheses

From the literature review and survey a hypothesis has been generated for the research project. Sekaran (1992:79) offered a reasonable description of an hypothesis as: "An hypothesis is an educated guess about a problem's solution. It can be defined as a logically conjectured relationship between two or more variables expressed in the form of testable statements. These relationships are conjectured on the basis of the network of

associations established in the theoretical framework formulated for the research study." Popper (1972:265) referred to hypotheses as 'provisional conjectures'.

The first (a qualitative null) hypothesis posited for this thesis is:-
'With a prime emphasis on supply, there is no fundamental difference between military and commercial logistics'.

From this hypothesis, coupled with the literature searches, a proposition has been developed (i.e. conceptual theory building) that logistics can be categorised (i.e. a logistics *typology* or *taxonomy*). This was illustratively modelled quadra-morphically in Figure 8.1 (page 226). This model is essentially a first attempt at *comparative logistics*. These commercial logistic types - one within each quadrant - are: Supply Network Management; Supply Chain Management; Expedition Logistics/Mobile Shop; and Responsive Logistics. These correspond respectively to military logistics as: War; Conflict; Focused Mission; and Terrorism and Guerrilla Warfare. For the military case an *umbrella term* can be used for the lower half of the construct, i.e. Project Logistics. Both these lower quadrants have a defined beginning and end to their logistics. Whilst for commercial/business logistics the expedition type is truly a 'project', the supply chain management quadrant for commerce can be employed for either a project purpose or, as an incessant operation. For example, a linear supply chain can be the normal material flow system for fulfilling market demand, and a linear supply chain could be set-up for the purpose of satisfying a 'one-off' (i.e. a project) demand situation like ceramic memorabilia for a royal anniversary, or a unique promotion. In all the logistics mode cases, service reliability is important and, technically, 'ousourcing' could/can be used.

So, the second hypothesis for this research is:-
'Both military and commercial logistics systems can be analysed and compared according to four distinct logistics types'. (As depicted in Figure 8.1 (page 226).)

Having stated these two propositions, the epistemological belief used here is that of a rationalist, in that hypotheses have been posited *a priori* with the intention of pursuing a deductive logic for the corroboration process (i.e. theory testing). The word *corroboration* has been used and not verification because as Popper (1972:251) wrote: "Theories are not verifiable, but they can be 'corroborated'". He (Popper, 1972:265) continued with an explanation: "I speak of the '*corroboration*' of a theory; and corroboration can only be expressed as an appraisal. (In this respect there is no difference between corroboration and probability.) Moreover, I too hold that hypotheses cannot be asserted to 'be true' statements, but that they are 'provisional conjectures' (or something of the sort); and this view, too, can only be expressed by way of an appraisal of these hypotheses."

For the corroboration (or appraisal) process, a Popperian (Popper, 1972 and 1974)

undertaking to seek for evidence to refute the hypothesis was pursued. This deductive refutation approach is a more rigorous validation process, for it could be self prophesising if only confirmatory evidence was sought, such that they coincided with one's own biases or prejudices. It is essential that one's own passions and prejudices are subjected to the dominion of logic, rationality and reason. The overall philosophical stance portrayed here is that of positivism incorporating the hypothetico-deductive methodology for the operationalisation.

The process of explanation-building follows a series of iterations and the steps involved have been listed by Yin (1994:111) as:-

"• Making an initial theoretical statement or an initial proposition about a policy or social behavior
• Comparing the findings of *an initial case* against such a statement or proposition
• Revising the statement or proposition
• Comparing other details of the case against the revision
• Again revising the statement or proposition
• Comparing the revision to the facts of *a second, third, or more cases*
• Repeating this process as many times as is needed"

An important aspect within this refining process is the leniency permitted to entertain, or allow, other *plausible or rival explanations* within the analysis (i.e. the case study evidence to be examined from a new perspective in a subsequent iteration should the theoretical position(s) be revised).

9.2.1.1 An Alternative

One of the alternative observational methods considered for this research was Analytic Induction. The process of 'analytic induction' described by Robson (1993:201) was:-

1. Formulate a rough definition of the phenomenon of interest.
2. Put forward an initial hypothetical explanation for this phenomenon.
3. Study a situation in the light of this hypothesis, to determine whether or not the hypothesis fits.
4. If the hypothesis does not fit the evidence, then *either* the hypothesis must be reformulated, *or* the phenomenon to be explained must be redefined so that the phenomenon is excluded.
5. Repeat with a second situation. Confidence in your hypothesis increases with the number of situations fitting the evidence. Each negative one requires either a redefinition or a reformulation.

Notes: Situations should be selected to maximise the chances of discovering a decisive one. In this way weaknesses are more quickly exposed. 'Situation' is used as a general term to indicate an instance, phenomenon, case, aspect (or whatever) that is observed.

As can be seen, this method is very similar to the hypothetico-deductive one outlined

earlier and as it requires repeated cyclical iterations because of stages 2 and 4, it is thus better suited to establish *causality*. Ragin (1987:37) draws the parallel (or points out the resemblance) to the technique of analytic induction with John Stuart Mill's (1843) *method of agreement* (which, essentially, proceeds by elimination). Although some similar procedural steps are to be used in this thesis, the final aim or purpose is to conduct a comparative analysis, not to seek causality. In reality, a combination of both deductive and inductive strategies/approaches were used in the manner outlined by Wallace (1971:11), who advocated combining inductive and deductive strategies; and because of the argument of Warwick and Osherson (1973:viii): "In fact, we argue ... that many of the difficulties encountered in comparative research could be greatly reduced by creative *combinations* of methods." They continued with the advice of: "The difference between the comparative and noncomparative wings of a discipline lies more in the range of variation considered than in a distinctive methodology."

9.2.2 Unit Of Analysis

For research convenience and manageability the military 'unit of analysis' selected was predominantly the supply within the British Army. Whilst forays were made into the Royal Air Force and the Royal Navy (as well as other public services like the Metropolitan and Thames Valley Police Forces), these proved valuable from a 'pilot study environment' standpoint as they helped in testing the construct validity for *rigour* in the Case Study design. However, the Army proved to be the most cooperative in degree of openness and interest. Also, the incorporation of the Navy and Air Force would have been too large a project as well as incurring much cost and time expense. Commercial samples chosen were an array of retail food and clothing replenishment systems with two non-retail cases. The decision processes (considerations and questions) passed through to arrive at these (and other) choices of the research design are displayed in Figure 9.1.

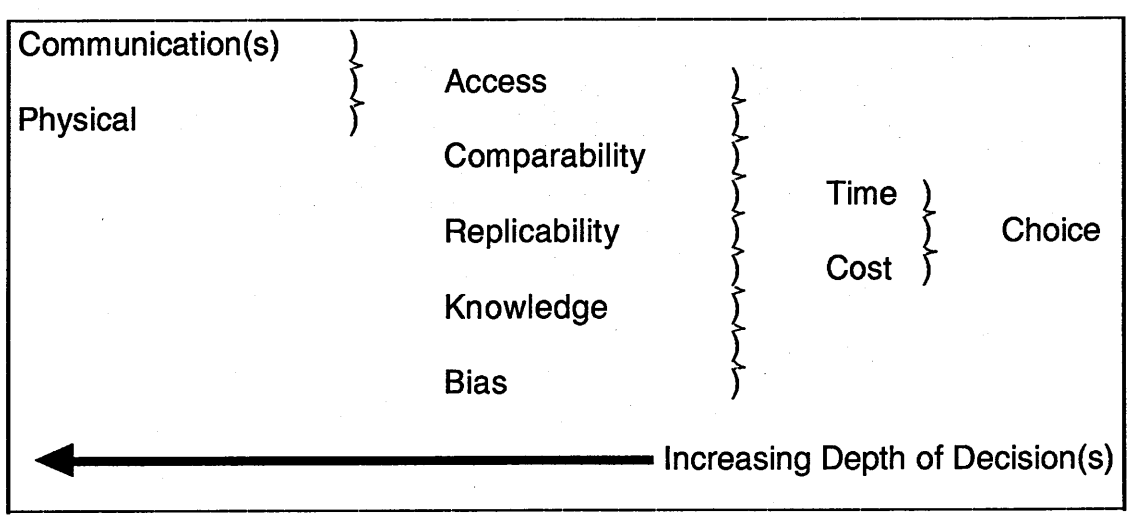


Figure 9.1 Constraints on Choice of Technique/Research Design

9.2.3 Data Collection

The selected method of data collection was via 'case study', which allowed multiple sources - i.e. an eclectic approach - of data acquisition and some flexibility in the research design (i.e. multi-method). This *freedom* was deemed necessary because of the political aspects appertaining to both sectors, i.e. the role and security matters of the military, and the commercial confidentiality regarding competitive advantage. Many of the procedures and techniques employed for, in, and during, the case studies conducted were those as suggested and described by: Stake (1995); Yin (1994); Robson (1993:146-169); Ragin and Becker (1992); Stoecker (1991); and Eisenhardt (1989).

Yin (1994:44) pointed out that cases may have sub-cases "embedded" within them, (this was the situation found in this research particularly within the British Army). He (Yin, 1994:38-41) also suggested single cases are the stuff of much qualitative research and can be very vivid and illuminating, especially if they are chosen to be "critical", extreme or unique, or "revelatory". Some research (e.g. process research) does not attempt to predict; it seeks to explain the interrelationship of various components and therefore even one observation/example may have validity. As Glaser and Strauss (1967:30) observed: ".. a single case can illustrate a general conceptual category or property, a few cases can confirm the indication ... it is not to provide a perfect description of the area, but to provide a theory that accounts for much of the relevant behavior." The principal techniques employed to obtain data within the case studies here were: visits, observations, structured and semi-structured interviews, some documentary evidence, historiography, a focus group and the Delphi technique/process.

Focus groups, which are formed of selected participants, are similar in some ways to unstructured interviews, and like them they are often used in the exploratory stages of a research project. The 'group leader' uses his or her expertise and knowledge of group dynamics to draw out group members' views, perceptions and feelings. Sessions generally begin with easy, specific questions to warm up the group, and then move on to broad collective issues that allow participants to expand on their ideas and attitudes about an 'area of interest' to a researcher. (The interactions can be audio taped, video-recorded and/or may be observed by other researchers through one-way mirrors. Although none of these recording media were used in the military session held for this research, the author made copious cogent, pertinent and specific notes from which *emerging main themes* were extracted.)

The Delphi method/process/panel permits selected (i.e. *experts* in their field) participants to provide (in their opinion(s)) accurate answers to questions, to state their premises, and to arrive at a consensus where possible. In the majority of cases this produces a rapid convergence of opinion which is of benefit, should time be limited or the field/study be *so wide*. The Delphi approach is an excellent exploratory tool for the

elicitation of research ideas, topics and questions; also, it can be used to test and consolidate conceptual ideas and views by consensus when the participants are experts, gurus or renowned players/practitioners/academics in the field - as was the case in this research, viz: four senior *experienced* military (Army) logisticians. Both the focus group and the Delphi panel provided confirmation, validation, and acted as a reliability check of the chief research areas, concepts, and interactions of variables, thus instituting robustness, and increased the confidence of the author in the validity of his findings and conclusions. (The data recording and findings of the focus group and the Delphi panel (which were both held with military (Army) personnel) were combined into one research unit which was coded M7 - which is explained in the next chapter, i.e. Chapter 10.)

9.2.4. Data Analysis

Analysis is basically a two step process: (i) the tracing of items/things/matters to their source, and thereby discovering the general principles underlying individual phenomena and; (ii) the resolving or separating of an item (a thing or matter) into its elements or component parts (i.e. *reductionism*, *disaggregation* or *deconstruction*). Apart from descriptive statistics, most of the data collected was qualitative and therefore the appropriate data analysis techniques were used. The qualitative data analysis process - post data reduction - followed many of the techniques advocated by Glaser and Strauss (1967); Corbin and Strauss (1988 and 1990); Robson and Foster (1989:85-99); Strauss and Corbin (1990); Robson (1993:370-407); Miles and Huberman (1994); Bryman and Burgess (1994); Yin (1994:102-126) and Maxwell (1996:77-81,109). The major steps were taken from the procedures offered by the use of grounded theory and the 'conditional matrix'.

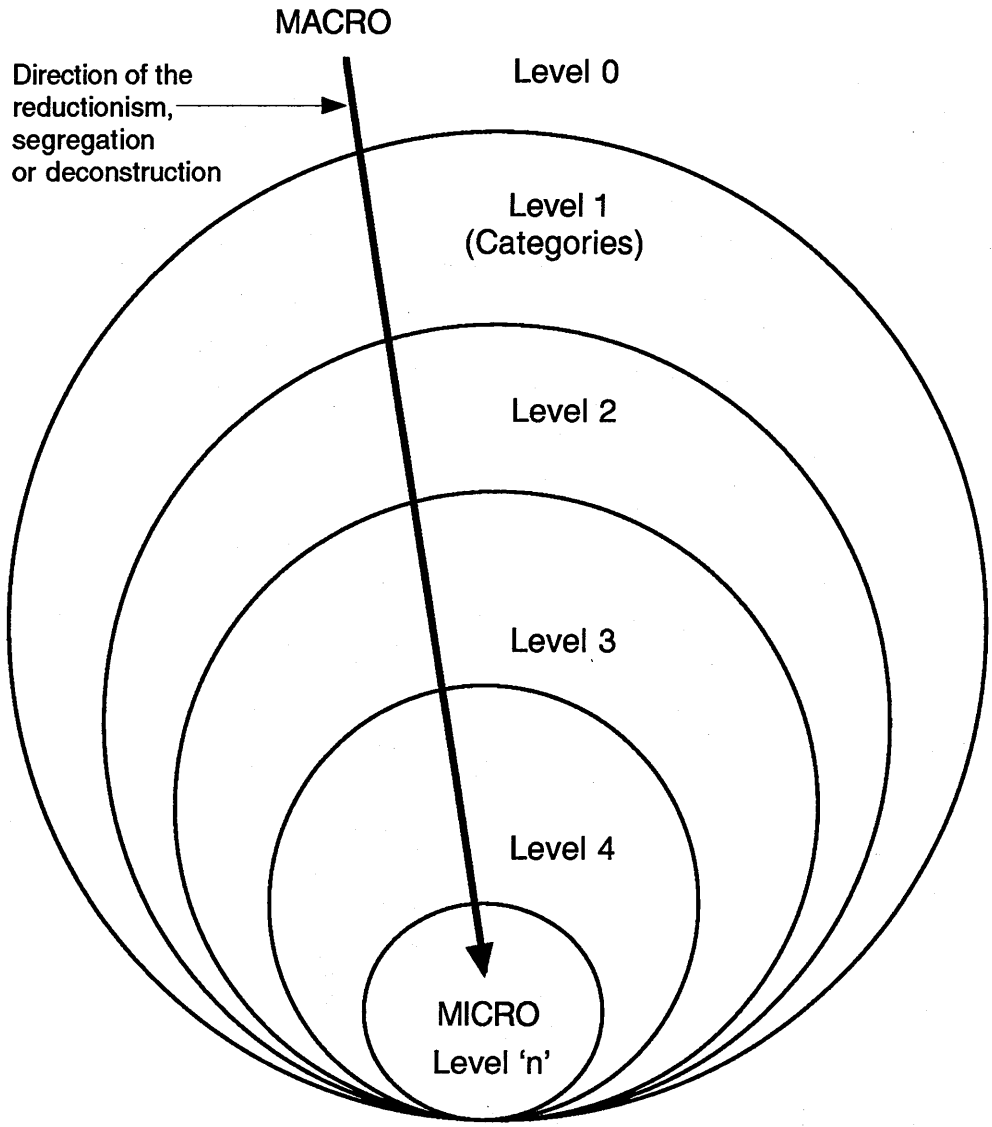
The developers of grounded theory (Glaser and Strauss, 1967:vii) defined it as a *general methodology* for developing theory that is grounded in data systematically gathered and analysed; theory evolves during actual research, and it does this through continuous interplay between analysis and data collection. A central feature of this analytical approach is "a general method of [constant] comparative analysis". Theory is *generated* and *elaborated*. Glaser and Strauss (1967:vii) argued that grounded theory would contribute toward: "closing the embarrassing gap between theory and empirical research." As they (Glaser and Strauss, 1967:224) asserted: " ... we have raised doubts about the applicability of these [the usual] canons of rigor as proper criteria for judging the credibility of theory based on the use of this methodology. We have suggested that criteria of judgment be based instead on the detailed elements of actual strategies used for collecting, coding, analyzing, and presenting data when generating theory, and on the way in which people read the theory."

An important feature of grounded theory is its "fitness", as Glaser and Strauss (1967:238-239) claimed: "A grounded theory that is faithful to the everyday realities of a

substantive area is one that has been carefully *induced* from diverse data. ... Only in this way will the theory be closely related to the daily realities (what is actually going on) of substantive areas, and so be highly applicable to dealing with them."

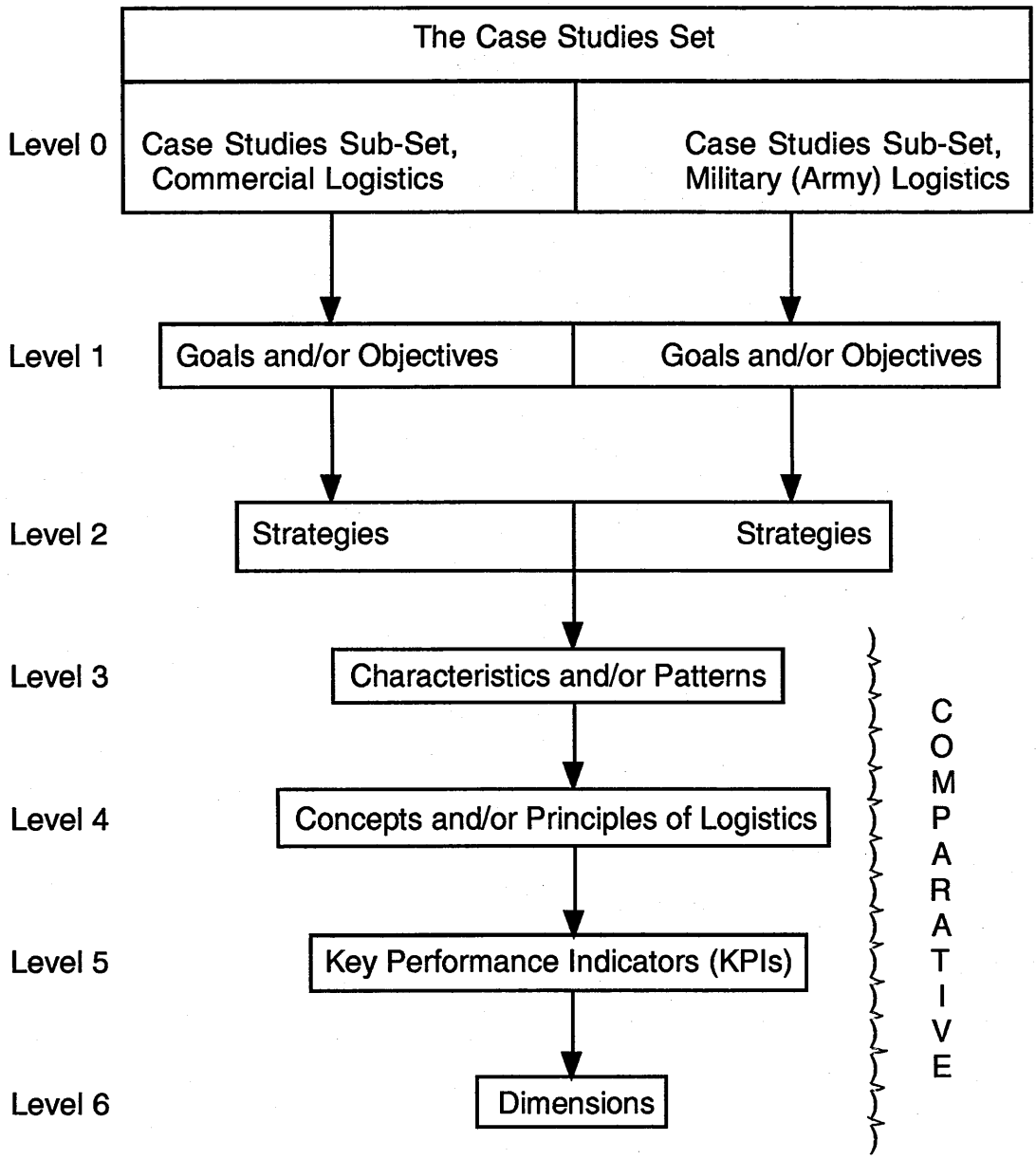
The conceptualisation and schematic of a "conditional matrix" (Corbin and Strauss, 1988; Strauss and Corbin, 1990) help towards specifying conditions and consequences, at every level of scale from the most "macro" to the "micro", and integrating them into the resulting theory. As Strauss and Corbin (1990:161) conveyed, this matrix can be visualised: "... as a set of circles, one inside the other, each [level] corresponding to different aspects of the world ... In the outer rings stand those conditional features *most distant* to action/interaction; while the inner rings pertain to those conditional features bearing *most closely* upon an action/interaction sequence." They continued (Strauss and Corbin, 1990:161): "The researcher needs to fill in the specific conditional features for each level that pertain to the chosen area of investigation, ..." regardless of which particular level *it* is. It is analogous to the layers of an onion (which is a three dimensional, almost concentric analogy); outer layers are peeled off to arrive at new inner layers. As layers are removed to reach closer to the centre, the *conceptual density* increases, and hence, understanding is augmented. A conceptual diagram of the conditional matrix is shown in Figure 9.2.

From the case study sets, cascading down to the sub-sets and with the conditional matrix scheme, the level categories/items and species/elements (or *categorizing strategies* as Maxwell, (1996:78-79) calls this analytic process) were designed as those depicted in Figure 9.3. Using coloured Stabilo pens (different colours for different categories) and different ringing geometries (circles, rectangles, triangles, etc.) for the lower taxonomic species, the texts, interviews and documentary data were coded to enable traceability or return tracking of *root sources*. Also, for the same reasons, alpha-numeric coding was employed for some of the sub-categories. The objective was to conduct an in-depth pattern matching excercise for the purpose of a comparative analysis using the ideas, techniques and methods suggested by Ragin (1987); Warwick and Osherson (1973); and Smelser (1973). Having a cognition of the environment and circumstances surrounding the case studies was important (in fact, necessary), as May (1993:153) stated and confirmed: "One aim of the comparative research is to understand and explain the ways in which different organisations experience and act upon economic, social and political changes, as the form of 'applied research', where the desire is to collect information for the research purpose." With reference to the comparability problem, Warwick and Osherson (1973) suggested that a *relational criterion* can be used to bypass the potentially unmanageable problems of comparing contents among distinctive groups: "Traditionally it has proved burdensome to compare the content of a specific tradition of a given society with that of another. ... One way of meeting these problems of comparability is to compare the relevant social groupings not in terms of content but instead with respect to certain intrasocietal relations experienced by each other, independent of the content of ..."



A two dimensional eccentric diagrammatic representation of the 'Conditional Matrix' as described by Strauss and Corbin (1990:161).

Figure 9.2 Schematic of the 'Conditional Matrix' Concept



Above are the selected items/aspects of the qualitative data analysis at each reduced level of the 'conditional matrix'.

Figure 9.3 Data Analysis Levels of the Research Design

Interestingly, as much of the literature (Maxwell, 1996; Miles and Huberman, 1994; Yin, 1994; Robson, 1993; Robson and Foster, 1989) advocated and encouraged, some analysis should be done during the data collection phase(s). The author found this to be true; analysis and comparisons with previously collected data, earlier analyses and findings were a common occurrence and helped with the pursuit of further/other relevant data, knowledge and quests. Early analyses also helped with short term memory issues and, if necessary, quick follow-up enquiries/confirmations with/of the data source(s) and details in the case studies. Particularly doing one's own transcriptions of interviews helped one to really 'get to know and understand the data' (Maxwell, (1996:79) called this analytic process *contextualizing strategies*). Coupled with the use of 'memoing' (Glaser, 1978; Robson, 1993:386-387) this 'analysing as you go along' approach, proved a very 'rich' and powerful technique for better contextualising, understandings, improvements/ameliorations, as well as preventing ideas and issues from being lost. (Indeed, as improvement examples: the quadra-morphic model hypothesis for this thesis had been modified about four times (i.e. the iteration explanation-building and, hence, theory building process); and the data analysis levels format/sequence/order was changed twice, as the author's knowledge and understanding improved via showing and explaining these to the case study participants and academics in the process of seeking 'conceptual validity', congruence and *resonance*.)

A comparative study was then entered into, which was an enquiry into the similarities and differences (i.e. the matching, or non-matching, of patterns) of the development and evolution (over, or, in a timeframe - i.e. the historical evolutions contained in Chapters 3 and 4), features, properties, processes, organisations and aspects of the two logistics sectors. The method sought to describe, compare and explain by identifying recurring (and individual or distinctive) patterns and practices which might have been widely separated by culture, purpose and/or scale. The aim was to classify logistics into types corresponding to particular demands/needs and requirements. It was an attempt, possibly, to locate individual features within a framework of an evolutionary history of - in this case - logistics, and especially for this thesis, the case studies that were conducted for military and business/commercial logistics.

From the final findings data displays via: tabulations of qualitative data; various types of matrices (Miles and Huberman, 1994:207-222 and 239-244); and models/constructs (i.e. *iconic* and *analogue* (Ackoff, 1962:109)) were devised.

The next chapter outlines/describes the case studies that were conducted for the work in this thesis.

10. DETAILS OF THE CASE STUDIES USED

"Facts are stubborn things."
Alain Rene Lesage

10.1 Introduction

As anticipated, live data was not very easy to obtain. Choosing cases from the military sector to support this work was not a question of being selective; although a set of preferred cases was drawn up, the requests to visit and research present day military cases were turned down. Probably the turning down of the requests was favourable to the author from a safety perspective, as the preferred cases for visits to the Northern Ireland forces and the ARRC in Bosnia were considered to be far too dangerous (i.e. mainly from the breach of operational security aspect). However, the reasons given apart from the safety and security aspects, were that the author was non-military and diversion from the focused operational objectives could not be tolerated. Some interviews have been held with soldiers who have served and completed a tour in those areas. Basically, for the military areas whatever opportunities were offered were gratefully accepted and pursued. Equally, the commercial sector presented barriers to obtaining live data too; but the reasons were of a competitive confidentiality nature because of perceived commercial advantage(s). It now becomes obvious why, so much time/work was spent on, and such a major proportion of the 'data trawl' was achieved via, historiography (i.e. Chapters 3 and 4) - the secondary research process. Below are the outline details of the case studies which supplied the qualitative data used for the primary research purpose of this thesis and the processes via which they were gathered/collected/captured.

In order to aid the choosing of suitable commercial case studies from the commercial sector a guideline set of criteria to comply with was drawn up. The list of criteria to select commercial cases to compare with the military was:-

- large scale/magnitude of operations;
- multi-product range and product heterogeneity;
- critical product supply;
- product weight range;
- a range of material handling types;
- multi-vehicular fleet range management;
- transport distances in excess of 50 kilometres; i.e. some trunking/stemming;
- product, and/or delivery, time critical;
- factors of production market example(s) as well as consumer market examples;
- an international element if possible.

Some businesses that were approached proved to be interested in the study but did not wish to share their experiences and knowledge, as they wished to retain their competitive edge and advantage(s) to themselves for as long as they could. For example,

an international company was approached and although initially it gave a positive reply for research access, it subsequently chose not to participate. Offering assurities of a five year embargo of the thesis was not sufficient to encourage their participation. This proved the pronouncement of Christopher (1992:14) "... the real competition is not company against company but rather supply chain against supply chain." Again in the commercial sector, whatever opportunities were offered were gratefully accepted and vigourously pursued too. So, for both the Army and the Commercial sets of case studies, *hybrid strategies* (in terms of methodology and analyses) had to be adopted because preferred case studies could not be found or guaranteed.

10.1.1 Types And Format Of Data

The comparative 'case study' approach adopted here allowed numerous types of data gathering techniques as well as the acquisition of them from multiple sources, which permitted flexibility within the research design. Data description and representation of the various logistics types, in particular quick response logistics, were sought. Overt non-participant observation, documentary analysis, literature search, Focus Groups (and Delphi approach), interviews with relevant prominent players and visits to many sites were the predominant data sources used here.

Systematic observations of effective logistics were conducted with a view towards delineating the conceptualisation of its rationale. Content analysis of documention was sought to match/corroborate observations; activities and processes that were representative were seen; for example, customer demand versus appropriate processes were checked. The purpose of obtaining data convergence was prompted by the need for reliability and validity checks. Also, as a final verification, all write-ups of the case studies were shown to the principals of the site(s)/meeting(s) asking for their sanction and comments. Changes to the monographs were made as appropriate.

The primary purpose of these investigations was to analyse the logistics principles and types (in particularly QRL) and limit it to the logistics types and QRL. It was decided to explore the problems and possibilities of a comparative investigation and to restrict the study to a limited number of roughly similar size cases which had very different structures and traditions; selective analyses of the system(s) then followed. The systems that were investigated and described were extremely different, not only in their structures, but also in the environment in which they operated.

In the case studies the uniqueness and originality of each system became apparent and therefore presented the opportunity for the author to comment freely on the experience demonstrated in order to assist his understanding. The cases were seen and written as analyses of a dynamic process of change and evolution of systems, and not simply as a report describing structures and mechanisms which currently existed.

10.1.2 The Case Study Protocol Employed

The basic case study protocol followed was:-

- an introduction to the purpose of the research and an explanation of the hypothesis;
- the same preset list of questions for each case;
- a brief historical review and discussion;
- recent developments;
- an analysis of systems - some were reluctant to reveal/show demonstrate these and made it a condition of the visit that this/these area(s) would not be pursued;
- an account of how logistical changes were made and how the system reacted to a changing environment;
- magnitudes and scale: changes in the relative magnitude of problems;
- means: were there any changed views about the relative effectiveness of different structures/processes and logistical solutions?
- and ends: were there any re-ordering of priorities?
- tour/visit around the site/venue;
- reading/review of various documentation - some declined to show benchmarking data;
- various interviews/exchanges with many personnel during all of the above; and
- final wrap-up and clarification session.

Through various decades, organisations have fluctuated their logistics according to politico-economic activity. Because of this, the justifications advanced for abandoning old structures and replacing them by different ones, and for changing the pattern of resource allocation, are difficult subjects to elucidate. According to Warwick and Osherson (1973:7): "Comparison in its broadest sense is the process of discovering similarities and differences among phenomena. ... comparison is central to the very acts of knowing and perceiving." However, following the methodological analytical comparison framework - the data cohesion process of: collation - grouping items; correlation - combining similar items; association - combining dissimilar items; and inferencing - concluding and proposing; the foremost stages of the procedure for this research was to search for:-

(i) basic similarities;
(ii) basic differences;
(iii) common trends;
(iv) the operation of the general principles which would help to relate apparently diverse phenomena; and
(v) where exchange of ideas could prove fruitful.

The case studies conducted here were (as best as was possible, given the restricted access) to provide the evidential basis which was necessary for a synthesis or for an analysis which would compare like with like and identify anomalous structural features in the military logistics patterns compared with the business/commercial logistics

operations and techniques. All the case studies conducted, 17 in total (7 military; 1 expedition; and 9 commercial/business) are in the Appendices - Chapter 14 (which commences on page 341).

10.2 Comments And Observations On The Case Study Approach

Case study weaknesses that were discovered:-

(i) the need to look at several factors in depth; and the correct choice of factors was vital to the design as the wrong choice would result in inappropriate information;

(ii) Hawthorne[41] (or experimenter) effect and the researcher's influence;

(iii) repeatability: would the same answers be given by different people in the same positions/jobs, etc? E.g. one interviewee (newly in post) just gave 'text-book' answers; and

(iv) representative: as many commercial entities saw logistics as one of their competitive strengths, they were not willing to reveal too much (especially information systems and benchmarking type and data) or allow visits; and, the military shrouded itself in national security coupled with the 'Official Secrets Act'. So access to preferred 'cases' was difficult and was not viable in many of the requested cases, (e.g. an international company, Northern Ireland and the ARRC). Therefore, any offers and/or opportunities were accepted in order to acquire *some* data.

During the operationalisation of the research it became evident that, taking a comparative stance with other objects and other judgements is the researcher's endless task. The author was convinced that his age and maturity were a big help once he had met with the participants who offered data, information and site visits. It became very clear that once the interviewees knew that the author had experience in the field and that contextual, relevant and pertinent conversations resulted in the course of the research data gathering, they 'opened-up and opened-out', sharing much more (in the author's view) than if the researcher had been a recent graduate with little or no practical subject experience. The knowledge gained via the initial reading and literature review contributed much in helping to elicit honest data and was beneficial in that rewards were reaped, in some cases in a 'bumper harvest'. The latter case(s) introduced some sensitivity considerations and discretion in the use, and sharing, of the data obtained. Also, when interviewees/people were not sure of the answers/responses to some of the questions/queries raised during the data gathering, they offered the names of, or introduced the researcher to those that probably could, which provided a *rolling sample*.

Interestingly, the same peculiarities from cultural history of social and economic development which illuminated the differences between military and commercial logistics

[41] The Hawthorne (or experimenter) effect is an effect on a subject's performance wrongly attributed to the manipulation of an experimental condition (*variable*) which can be shown to be due to the influence of the experimenter.

tended to (or may have) obscured the fact that the two sectors followed similar philosophies.

10.3 The Military Set Of Case Studies

Seven specific military case studies were conducted and these were coded M1 to M7 for ease of handling. Case M1 was an historical base. Cases M2 to M6 were embedded case studies of the British Army, and M7 was a Focus Group and Delphi Group/Panel exchange (which consisted of 20 senior personnel in total). The total military case studies set is tabulated in Table 10.1 together with scientific expedition logistics, which was coded E1. Each case study's details is in the Appendices, i.e. Chapter 14 (commencing on page 341), but a brief description of each follows:-

M1: Consisted of literature search/survey, original film footage and information appertaining to the logistics of the 1899-1902 Boer (South African) War. (This war was chosen because currently it is approaching its centenary.)

M2: Consisted of a visit to the Royal Logistics Corps (RLC) of the British Army on the Rhine (BOAR) in Germany at three locations: Sennelager; Gütersloh; and Herford. This series of visits was a good cross section of the logistics support complement for the British Army in Germany.

M3: Consisted of attending for three days the RLC component of a military exercise in preparation for a tour in Bosnia. The entire logistics supply chain incorporating Bicester, Abingdon and Salisbury Plain was followed and observed. The Base Ordnance Depot (BOD) at Bicester had a total area of 659 534 m^2, employed 1 317 civilian staff and 204 military staff; the number of items held was 44 476 with an inventory value of £420 million. A typical monthly number of vouchers (i.e. number of items requested) handled was circa 108 000.

M4: Consisted of visits to a Regional Depot/Warehouse, Loan Pool and Repair Centre at Thatcham, Berkshire. The total area of the depot was 91 685 m^2 where 228 civilian staff and 2 military staff were employed. This depot housed the Adventure Training equipment for the whole of MoD - i.e. for Tri-Service.

M5: Consisted of visits to the BOD at Donnington, Shropshire. This Depot had a total area of 525 777 m^2; employed 1 388 civilian staff and 247 military staff; the number of items held was 264 927 with an inventory value of £1 509 million. A typical number of vouchers (i.e. number of items requested) handled per month was circa 121 000.

M6: Consisted of interviews and discussions with military personnel who were employed at the Northern Ireland RLC Depot in Lisburn.

M7: Comprised a Focus Group and a Delphi Group. The Focus Group discussion and exchange participants were army/military personnel (of ranks Lieutenant Colonel through to Brigadier) from UK Land (i.e. the fighting front-line), Royal Electrical

THE MILITARY (UK ARMY) AND EXPEDITION CASE STUDIES SET

Case Study Code	Brief Description	What Exactly?	How The Data Was Collected and Type
M1	The Boer War of 1899-1902 (South African War)	Real War, Historical	Historiography and Literature Search/Survey; - Secondary Data and original film footage
M2	British Army on the Rhine (BAOR) - Germany	Real Life, Operational	Visits, Observations, Interviews and Discussions; - Primary Data
M3	Operation Crusade - Abingdon and Salisbury Plain; and Bicester - Oxfordshire: Base Ordnance Depot (BOD)	Exercise & RLC* Base, Central Warehouse and Stores for Consumables	Non-Participative Ethnography, Visits, Observations, Interviews and Discussions; - Primary Data
M4	Thatcham - Berkshire: Regional Depot	Warehouse; Loan Pools & Repairs	Visits, Observations, Interviews and Discussions; - Primary Data
M5	Donnington - Shropshire: Base Ordnance Depot (BOD)	Central Warehouse and Stores for Hardware/Instruments	Visits, Observations, Interviews and Discussions; - Primary Data
M6	Lisburn - Northern Ireland: Logistic Support Headquarters	Operational Regional Base Depot	Interviews, Discussions and Explanations; - Primary Data
M7	Venue Tidworth - Hampshire: Discussion/Verification	Focus Group and Delphi Perspective	Interviews, Discussions and Explanations; - Primary Data
E1	Scientific Expedition Logistics and Support	Conference Attendance at RGS** and Literature	Lectures, Interviews, Discussions, Literature and Explanations; - Primary and Secondary Data

* Royal Logistics Corps ** Royal Geographical Society

Table 10.1 The Military (UK Army) and Expedition Set of Case Studies

and Mechanical Engineers (REME), and the full range of RLC, with senior civilian personnel from MoD headquarters, Bicester and Thatcham Depots in attendance too (16 participants in total). The main questions used for the focus group are in the Appendices, Section 14.7.1 (page 385). The army Delphi Group/Panel review, validation, reliability, discussion and general consensus consisted of two Brigadiers and two Major Generals (i.e. four *very experienced* senior army logistician).

10.3.1 Expedition Logistics

For tidiness and ease of display, the category of Expedition Logistics has been included in Table 10.1. It was given the code of E1 and was made up from the following components:-

E1: Constituted the work completed to study expedition logistics. This was composed of attendance at an 'Expedition Logistics Conference and Exhibition' held at the Royal Geographical Society (RGS); interviews with expedition logisticians; and literature surveys/searches (N.B. this was probably the *most* eclectic of all the case studies).

10.4 The Commercial/Business Set Of Case Studies

Nine specific commercial/business case studies were conducted and these were coded C1 to C9 for ease of handling. The commercial/business case studies set is tabulated in Table 10.2. For the case studies C1, C2, C3, C4 and C7 anonymity was requested by the owners and operators and, therefore, only limited descriptive statistics will be given. The case studies' main data are in Chapter 14 (commencing on page 341); however, a brief description of each case follows:-

C1: A High Street multiple retail store consisting of over 280 stores nationwide with some stores abroad. Whilst expansion abroad was a part of its corporate strategy, presently some 80% of revenues came from the UK stores network. (One interview transcript sample from this case study is included in Chapter 14, Section 14.9.2 (the transcript starts on page 394).)

C2: A third party managed logistics sortation and consolidation centre for C1 above handling boxed and hanging goods and covered (i.e. serviced/replenished) 18 stores in the south and south-west UK. Goods were received from circa 200 suppliers.

C3: A third party managed logistics sortation and consolidation centre for C1 above handling chilled and dry ambient foods and covered stores in the south and south-west UK. This organisation belonged to the same parent company as C2.

C4: A third party managed logistics sortation and consolidation centre for C1 above handling boxed and hanging goods and covered stores in London and its suburbs; The centre received goods from circa 200 suppliers. The parent company of this service provider was not the same as C2 and C3.

THE COMMERCIAL/BUSINESS CASE STUDIES SET			
Case Study Code	Brief Description	What Exactly?	How the Data Was Collected and Type
C1	High Street Store - Multiple	Retailer, Operational	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C2	Third Party Managed Logistics: For C1 Above - Wiltshire. (Covering South and SW UK)	Regional Sortation and Consolidation Centre for Boxed and Hanging Goods	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C3	Third Party Managed Logistics: For C1 Above - Berkshire. (Covering South and SW UK)	Regional Sortation and Consolidation Centre for Chilled and Dry Ambient Foods	- Visits, Observations, Interviews, Documentation and Discussions - All Primary data
C4	Third Party Managed Logistics: For C1 Above - Outer London. (Covering London and Suburbs)	Regional Sortation and Consolidation Centre for Boxed and Hanging Goods	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C5	Third Party Managed Logistics: Exel Logistics For British Home Stores (BhS) - Atherstone, Warwickshire.	National Sortation and Consolidation Centre for Boxed and Hanging Goods	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C6	Levi Strauss (UK) Ltd: - Northampton, Northamptonshire.	National Warehouse, Consolidation and Distribution Centre for Boxed and Folded Clothing	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C7	Third Party Managed Logistics: For Another High Street Store Multiple - Wiltshire. (Covering South and SW UK)	Regional Warehouse, Consolidation and Distribution Centre for Frozen, Chilled and Ambient Foods	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C8	British Steel Service Centre: - Colnbrook, Buckinghamshire.	Regional Customer Call-Off and Service Centre	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data
C9	Nationwide Building Society: - Swindon, Wiltshire.	National Internal Printing, Mail Distribution Centre and Warehouse	- Visits, Observations, Interviews, Documentation and Discussions - All Primary Data

Table 10.2 The Commercial/Business Set of Case Studies

(*Nota bene*: The case studies C1, C2, C3 and C4 were permitted by the C1 company at the request of the author but, conditions where imposed whereby IT/IS investigations were disallowed as was other confidential data particularly relating to benchmarking and future strategies. Therefore, only the data that was allowed/sanctioned by C1 was used in this thesis. C1 requested total anonymity and confidentiality throughout too.)

C5: A third party (i.e. Exel Logistics) managed national sortation and consolidation centre for British Home Stores (BhS) and Mothercare handling boxed and hanging goods and covered the whole UK - servicing 270 stores and receiving from 140 suppliers.

C6: A national warehouse, consolidation and distribution centre owned and managed by Levi Strauss (UK) Ltd. handling boxed and folded clothing and covered the whole UK. Goods were received from Scotland, France and USA as well as England.

C7: A third party managed logistics warehouse, consolidation and distribution centre for a High Street multiple retail store handling frozen, chilled and ambient foods and covered the south and south-west UK. The retail store (a different one to C1) had over 750 stores nationwide, and the third party operator was a different one to C2 and C3, C4 and C5. (Anonymity was requested by the client and operator.)

C8: A regional customer call-off and service centre which was owned and managed by British Steel plc (the third largest steel producer in the world), handling and cutting to size various types of sheet steel and covered the south UK. The centre, as a result of two restructurings of the company in five years, now had 57 heads from an original 202. The output of the centre was 1 700 tonne per head per year.

C9: An internal printing and national mail distribution centre owned and managed by Nationwide Building Society and covered the whole UK.

10.4.1 Comment About The International Aspect

It will be noticed that the commercial/business set of case studies does not include an international sample. This was not by choice. An international organisation was approached and, initially the idea of their being used as a case study met with approval. However, the many requests for access seemed to have been 'bounced around' the organisation with no confirmation or suggestions for the data gathering process. As these requests (and their follow-ups) spanned a nine month period, the author thought it best to cease contacting and asking various personnel about the progress with his gaining access. Although an international sample would have been ideal, on reflection, the need for it was probably superficial; the reason being that the real *bugbears* to international/global business logistics are: the 'customs and excise' (C&E) aspects and issues; the different document standards from place/area to place/area; the lack of *truly global* carriers; the interfacing/integration/connection and protocol problems of IT/IS arrangements; the possible cartel practices/aspects of sea-shipping; and the abuttings of different national cultures. As the military are *exempt* from the customs and excise

aspects/issues (except in very unusual circumstances and, excluding *guerrillas* and *terrorists* - who actually subvert C&E), the functions of purchasing, acquiring, transporting, handling, storing, sorting, consolidating, consigning, dispatching, distributing, etc., and getting materials/goods to a prescribed destination were likely to be generic for both sectors. In fact, when observed from this standpoint, the military of today, which has to sustain itself throughout its campaigns in 'out of area' domains anywhere on the globe, is probably a *truly global logistics carrier/provider*. The 'would be' commercial global carriers could probably benefit from some of the knowledge and experience that the military possess in international/global logistics.

The next chapter contains the analysis and discussion of all the gathered data for both the primary and secondary researches.

11. ANALYSIS

"The opposite of a correct statement is a false statement. But the opposite of a profound truth may well be another profound truth."
Niels H.D. Bohr (1885-1962)

This chapter contains an examination of the relationships, correlations and phenomena by *pattern matching* arising out of the literature surveys/searches, historical evolution work, theories, variables and the case studies carried out for the purpose of conducting a comparative analysis of military (principally Army) versus commercial/business logistics. Throughout, the reference to specific case studies is via use of the ascribed codes as depicted in Tables 10.1 (page 250, for the military/Army and expedition) and 10.2 (page 252, for business/commerce).

11.1 Evolution/Progress Of Logistics Integration

From the historical evolution work (i.e. the secondary research work of Chapters 3 and 4, but particularly the summary evolution tables of Sections 3.6.1 (pages 116-120) and 4.5.4 (pages 154-157)) it appears that the progress of logistics integration followed the same path in both the military and commercial domains (i.e. there is a pattern match) but at different times and within different periods; the military for example, only set-up integrated infrastructures for specific wars/campaigns/conflicts. It appears that the speed of changing circumstances that both sectors had to respond to, and satisfy, was the stimulus for developing faster communications and/or information/data transmission; in fact they were/are probably proportional to each other. For real integration, IT/IS with data capture and visibility throughout the whole logistics chain or network is essential, but nevertheless, evidence is available that shows the principles of integration were practised by the military long before computers. Therefore, in this comparison, integration is taken as far as the principles allow without computers and modern communications.

The three principal logistics integration types are: *Internal*; *Channel*; and *Spatial (or Global)* and their progress normally followed through the stages/sequence as listed (see Figure 11.1). The *internal integration* within an enterprise/organisation is composed of bringing together, coordinating and managing the three originally separate logistics components/functions of inventory, warehousing and transportation. The military became aware of the interdependence and benefits of internal integration from the very earliest of offences and/or defences, i.e. pre-700 BC, when they set-up - what we would call today - a *campaign inventory structure*. The 'magazine' system of the 17th century was the culmination of military internal integration. Evidence of internal integration in the military case studies were observed/found in M3, M4, M5 and M6. For modern commerce/business this internal integration took place seriously during, and around, the 1970s. As Sussams (1992:1) stated: "One reason for the emergence of logistics as a

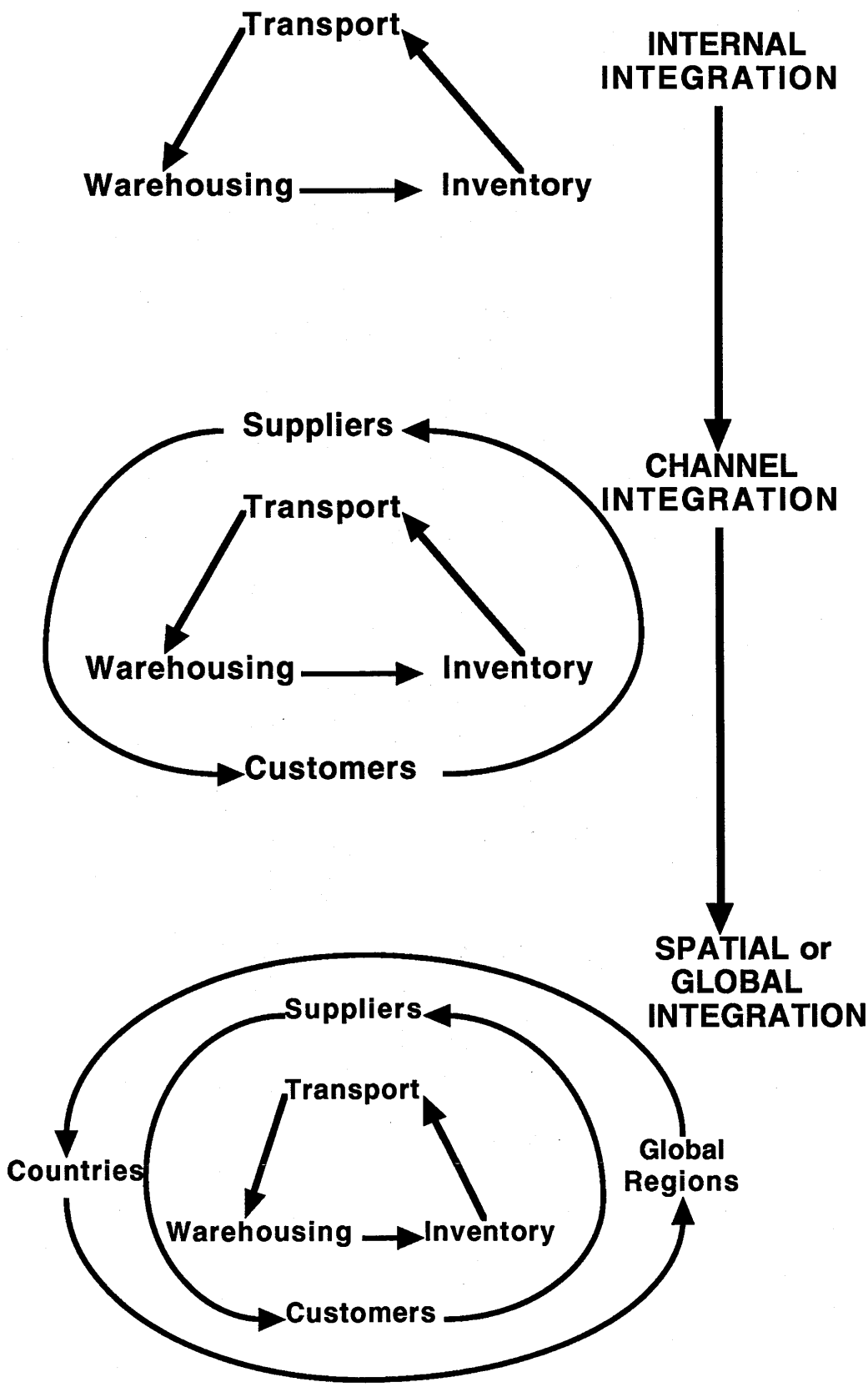


Figure 11.1 Progress/Stages in Logistics Integration

major function in modern business was the evident need for a discipline that would integrate a set of hitherto disconnected subsystems, each jealously guarded by its own territorially-conscious manager." Evidence of commercial/business internal integration was observed/found in the case studies of C6, C7, C8 and C9.

Channel integration followed, which superimposed suppliers and customers/end-users onto the internal integration concept. For the military, channel integration probably started with the Romans - circa 250 AD - was employed by the Byzantines around 500 AD and was considerably improved by Charlemagne in circa 770. Napoleon's 'predatory' warfare (circa 1809) utilised the principles of channel integration. From the field work, channel integration in the military was observed/found in the case studies of M1, M2, M3, M6 and M7. This seriously took place around the early 1980s for modern commerce/business within industrial markets as well as in consumer markets, with postponement (proximity placements of inventory and deferred differentiation) concepts playing a large role to offer customisation and responsiveness. In the case studies of C1, C2, C4, C5, C6 and C7 the channel integration pattern was observed/found.

Finally, *spatial (or global) integration* came into effect. This is the super-imposition of countries and global regions (i.e. globalisation/glocalisation) onto the channel integration concept. This took place for the military from the time they began offences out of their area, or, in other countries and supplies/support were/was brought from the home base. Charlemagne, circa 775 AD heralded the real spatial integration beginning for the military, although some evidence exists suggesting the Romans moved in that direction. The Seven Years' War (1756-1763) - the first *real* world war - enabled further military advancements with international integration of logistics. The military perfected spatial/global integration as far as was possible at the time of the introduction of the railways and steam-ships in circa 1830s. Examples of spatial integration in the British military are the Seven Years', Crimean, Boer, Falklands and Gulf Wars. Serious, real spatial/global/glocal integration for business/commerce began about, or in, the late 1980s. It was the advent of advanced computing concepts (like wide-area-networks (WANs)) that permitted such a global logistics vision. Naturally, international trading has been happening for millennia, but the processes and functions involved were managed/handled separately/individually and in a fragmented manner. No real spatial or global integration was found in the commercial case studies because the investigation of this aspect was not permitted, given that the international companies/enterprises approached for research data declined to participate in the research; although some evidence of it was picked-up in C1 and C6. Of course IT/IS is a great and powerful enabler in all of the logistics integration types, but particularly within the spatial/global/glocal desegregation sphere of businesses today - both in the industrial and consumer markets.

The major benefits from integration are *time compression* (i.e. speed) and *cost*

reduction. For the military it was mainly the time compression/speed aspect which stimulated integration and the cost benefit was a bonus. For businesses the cost reduction aspect was the stimulus for integration and the time compression/speed a secondary benefit initially but, subsequently time shrinking became equally important. For both sectors today, both time/speed and cost are stimuli for better and tighter integration of the logistics chains/networks, using postponement concepts where appropriate and necessary, with high levels of responsiveness, service, competitiveness, availability, product range choice and customer satisfaction/delight as outcomes.

11.2 The Evolutionary Comparison Analysis

Having established and compared the logistics integration evolutionary features, a look at the convergence and/or divergence of the logistics between the two sectors appeared a logical next step - it proved a fascinating exercise - and this is undertaken now. For ease of data management and to have a meaningful outcome, the historical journey is categorised into three identifiable sections which are: "The Early Years"; "The Industrial Years"; and "The IT/IS Years".

11.2.1 The Early Years - Up To 1800

The salient data from the two historical evolution summary tables of Sections 3.6.1 (pages 116-120) and 4.5.4 (pages 154-157) were tabulated side by side for the two sectors in Table 11.1 which covers the period up to 1800. The cogent points that emerged were as follows.

Clearly, from the beginning of time, a nomadic hunter-gatherer fended for himself, his family and/or his band by living-off-the-land/country. This person must have realised that the 'band size' was a major factor in the survival stakes and therefore new/breakaway bands formed when some 'optimum size' was established for both the band's living support ease and its defence. Should his family and/or band be attacked, then defensive measures, surely, would have been taken; likewise, if he and his band were on the offensive, appropriate measures would have been followed here too. The hunter-gatherer was a quadruplicity of civilian/farmer, traveller, hunter and warrior; therefore his knowledge of logistics, such as it was, would have been interchangeable for all his purposes using his nous, knowledge of climates/seasons and terrain, and supported by the resources - such as they were (natural resources; stored self farmed grain/produce; self-fabricated tools, hunting equipment and weapons; horses; other animals; the wheel when it was invented; and characteristics like portability; etc.) - at his disposal. No doubt at that early point, the principle of static defensive tactics being easier than mobile offensive aspects was discovered and learnt. As all the knowledge and/or any learning was centralised within the band/community, logistics advanced together, in parallel and coincidentally, for military use and ordinary civilian living/survival.

Historical Evolution of Military Logistics:-

Consideration has always had to be given to terrain aspects and weather (climatic) conditions.
Pre-wheel days - everything carried by warriors and/or beasts of burden.
Portability of items and demand for horses for mobility.
Horse drawn wheeless 'drag-barrows', travois or stretchers.
Foraging, 'live-off-the-land/country' and local stores/small magazines.
Soldiers/warriors were probably craftsmen as well as fighters.
Construction of some 'tools of war' from local materials at the site of use, therefore did not carry/transport/bring them.
Solely carried/brought valuable, difficult to produce weapons/tools.
Diseases were commonplace - no cures or medical care.
The wheel was invented - handcarts, animal drawn carts, and large wooden aids like battering rams, etc. constructed at site of use.
Defensive/static logistics - castles/walls/towers with storage facilities.
Sustainment via one's enemies' supplies/stores/facilities.
Short wars were less of a drain on resources.
Small groups were easier to sustain and more mobile - thus large armies were often split-up into many small groups.
Use of boats on water/rivers/canals to transport soldiers/fodder and these were used as floating storage/magazines.
The Romans: built good roads and access facilities; set-up specific supply/logistics tasks; had strategically placed stocks/magazines; used supply-lines; conducted amphibious landings; created good field engineering; and had some standardisation of equipment.
Introduction of supply trains; mobility strategies; readiness tactics; all of which were backed-up by the taking of 4-5 remounts per soldier.
Purveyancing system with merchant shipping and the Military Etape System; some use of 'free quartering' and civilian support.
Gunpowder and cannon were developed making weight, handling and safety of carriage more difficult.
Use of 'scout masters' and 'gallopers' for intelligence gathering.
Cause of scurvy was a lack of fruit/vegetables (vitamin C) in the diet.
Water (rivers/canals/seas) was the principal transport medium.
Global transportation/logistics with vast shipbuilding programmes carried out by the British who gained ocean/sea supremacy.
Discovery that large scale logistics required good administration, planning and appropriate training.
Combinations of magazines to stock supplies and foraging were used.

Historical Evolution of Commercial/Business Logistics:-

Nomadic - hunter-gatherer bands, 'live-off-the-land' with regard to seasonality; everything carried by people and/or beasts of burden.
Portability of items and demand for horses for mobility.
Horse drawn wheelless 'drag-barrows', travois or stretchers.
Stable/concentration of populations; farming communities and large storage arrangements for grain, to cover times of drout, etc.
Centralised exchange points - market villages/towns.
Clay pouch/purse with stones for proof of number of livestock owned by trading party.
Most bulk transport was via rivers/canals.
Specific overland trade-routes (Silk Road, etc.) developed with camel trains/caravans.
Dispersion (nomadic) and/or concentration of people (demography).
Sea-going sailing ships developed/built by the Egyptians.
Roman road system/network aided commercial travel and trade.
The Crusades, for their requirements/needs, established transport and supply channels in central southern Europe and the Mediterranean which were then continued and further developed by the merchants and traders of the area.
The Etape system - centralised provisioning hubs/centres.
Transatlantic trade.
Branding of wooden crates by the sender/supplier.
Smuggling and contraband trade/sales brought about concepts like:- ease of handling; concealed storage; geographical postponement (proximity placement(s)); and night-time movements.
Construction of canals to: enhance water transport aspects; reduce distances travelled; and/or reduce/save time and costs.

Table 11.1 The Early Years Historical Comparison of Military Vs Commercial Logistics, Up to 1800

When the need arose, or was identified, to segregate mass defence (or offence) measures from the way of *normal* every-day life, then possibly the two strands of logistics separated/diverged? For instance, as water transport was the most practical and therefore the most common type in the early days, the ships/vessels were designed and built differently for their purpose: the Egyptian, Greek and Roman galleys and the Persian 'man-of-war' were designed and built as fighting ships; merchant cargo carrying ships/vessels were designed for their load carrying and ease of loading/unloading. Probably, it was because of the specific/special needs of the separated military sector that the design, fabrication/manufacture, maintenance/upkeep/repair, deployment and disposal of weapons/tools of war, etc. were carried out by the military itself. The military therefore developed appropriate logistical knowledge and learning for its purposes - like the example just given, practising what is called today 'internal integration'. The era of Alexander the Great is a good example of creative logistics development of, and for, military sustainment (e.g. dividing the army into smaller units so that foraging would be easier (the same argument as the optimum 'band size' mentioned earlier, etc.); and the Romans divided and carried out their logistics differently according to commodity type: water; firewood; animal fodder; and grain/other provisions. These separated functions and the supply depots/fortresses that the Romans established, coupled with the 'supply trains' they used, were early signs of 'channel integration'. Likewise for the civilian merchant/trader; he too developed his logistics knowledge/learning for his own advancement towards his objectives; for example holding stocks in heavily populated areas/towns that were/became centralised exchange points (i.e. market towns (the development of towns in England was the handiwork of the Romans, i.e. concentrations of populations)) which later developed into staples or etapes. So, there occurred a move away from a combined civilian/hunter/warrior logistics, to a segregation, or divergence, of logistics for military and non-military.

Society generally developed with the agricultural development/expansion, whereby produce was grown and harvested for its locale, each area supplying its surrounding population (the agricultural based economy). As the size/magnitude of military campaigns became bigger, the need for its sustainment grew too, so magazines were established and help from the non-military was sought - sometimes this was just requisitioned/purloined/taken/stolen by the military, other times proper procedures were set-up or followed with the military paying (or possibly exchanging/bartering - like tax concessions and *tithe* type arrangements, etc.) for the goods/equipment/food/services it received. This gentlemanly and commercial manner of coexisting brought about a duality of purpose for logistics and the two sectors aided each other. When supply trains were introduced for the military, there were both 'self-managed' and 'bought-in' structures. Indeed, commercial provisioning via sutlers existed from very early times.

The roads that the Romans built primarily for military sustainment were a tremendous asset for commerce/trade, etc. (In England alone, the Romans built over 6

000 miles of roads.) The needs of the Crusaders were such that the systems/procedures/arrangements set-up to sustain them were continued after the Crusades by merchants/traders, and further improved upon, for commercial gains. When Genghis Khan advanced westward, his route generally followed the commercially established 'Silk Road'. Even the designs of commercial ships for easy loading and unloading proved useful for military purposes in order to conduct amphibious attacks/campaigns (which were plentiful during this period). Hence, it can be seen here, that a convergence of logistics occurred.

The 'early years' followed a pattern of logistics between military and commerce that went: from coincidence to divergence and then convergence.

11.2.2 The Industrial Years - 1800 To 1970

The principal comparative evolutionary aspects for the period 1800 to 1970 have been tabulated in Table 11.2. Points of particular noteworthiness are referred to below.

Interchangeable parts, which were developed for military purposes, were probably the commencement of the "Industrial Age". The concept of interchangeable parts came from Italy: the Arsenal of Venice was using some standard parts in the manufacture of warships as early as 1436. The French gunsmith Honore LeBlanc produced musket components manufactured using interchangeable parts in circa 1785. However, it was two New Englanders, Eli Whitney and Simeon North who proved the feasibility of interchangeable parts as a sound industrial practice. At Thomas Jefferson's urging, Whitney was contracted to produce 10 000 muskets for the US government in 1801. Although it took him until 1809 to deliver the last musket, he established beyond dispute the workability of what he called his "Uniformity System". North, a scythe manufacturer, confirmed the practicality of the concept and devised new methods for implementing it, through a series of contracts between 1799 and 1813 to produce pistols with interchangeable parts for the US War Department. These inspirations and ideas were realised on a large scale for the first time at the Springfield Armory, Massachusetts, between 1815 and 1825, under the control of Colonel Roswell Lee. Many nations were becoming industrialised during the early 1800s with the prime focus on producing 'tools for war'; for instance, in France, during circa 1797-1806 Napoleon built foundries and factories for the manufacture of weapons and munitions. The military led the technological revolution in manufacturing and businesses adopted the ideas of the military innovations to produce consumer goods some years later. So the military was the leader in manufacturing logistics, with business being a follower; for example it was not until the early 1900s that commercial exploitation of interchangeable parts and flow-line assembly operations were introduced to make consumer goods like cars.

The steam engine was probably the next significant advancement for both transport -

Historical Evolution of Military Logistics:-

The building of factories and foundries for the manufacture of weapons/munitions - plus the development of manufacturing.
Developed logistics thinking and good field engineering.
A leaning towards the standardisation of artillery.
Wars/battles on multiple fronts tested and taxed logistics.
Development and use of the 'Contract System' for supplies/food.
Lime juice was introduced as a scurvy preventive agent.
The steam-engine allowed the introduction of the railways and then military steamships with strategically placed coal depots/bunkers.
Interdiction of enemy's supply lines/umbilical cord(s)/war production.
The telegraph was established.
The ambulant magazine concept.
Organisation, relationships and only the necessary administration were seen as crucial for good logistics - causing many military supply reviews to be conducted.
Medical care/hygiene & nursing of injured soldiers/sailors commenced.
Industrialisation caused many new and modified weapons/kits to be introduced and the attendant problems of variety became apparent.
Standardisation and interchangeability of equipment/weapons and munitions for one party became a component of necessity and further helped by making the continued use by one's enemy of the captured weapons/equipment difficult or impossible.
Stockpiling and War Maintenance Reserves (WMR).
Strategically placed supply bases became commonplace.
A move from centralised to decentralised responsibility for logistics.
Communications and information transmission via: heliographs; semaphore; air balloons; cyclist messengers; and early field telephones.
Concentration camps used - warehouses for retaining prisoners.
Industrialised wars brought about the realisation for a proper logistics infrastructure; 'links and nodes'; and tailored logistics.
Motorised land and air transport introduced bringing fuel supply and maintenance support into the logistics equation.
Pipelines used to supply water/fuel over long land/sea distances.
Chemical warfare with the safety, storage and handling problems.
Aircraft carriers and air-to-air-refuelling (AAR) introduced.
Dehydrated/compact foods extended storage life and made supply easier.
Introduction of the "Requisition System", i.e. pull demand.
Material handling techniques like palletisation and containerisation.

Historical Evolution of Commercial/Business Logistics:-

Generally, dispersed population in the USA versus urbanised population in Britain - demographic changes.
A move away from an agricultural based economy towards a manufacturing (in concentrated regions) based economy.
Emergence of railways with a switch from continental inland river and canal barge-freight to rail-freight. The quest for good 'railway management' brought about the development of accounting and performance ratios to indicate where improvements and efficiencies could be found and made.
Emergence of steam-ships enabling the speeding-up of transoceanic (global) transportation and trading.
Three kinds of selling developed: sale by bulk; sale by sample; and sale by description.
The 'Pony Express' was inaugurated in the USA as a specific service which was ceased a year later when the telegraph was introduced.
Evolution/emergence of middlemen/distribution channels.
The construction/opening of many shipping canals.
The 'stockturn' ratio was developed.
Trucks/lorries and cars (internal combustion engine) became familiar.
Development of aircraft followed by commercial passenger and freight services - reducing long range transport times.
Marketing/logistics concepts: time, place and possession utility; relevance of volume to costs; designed channels of distribution; balancing of supply and demand; and service (direct and collateral).
Logistics concepts: quality (via grading); recognition of lead-time factor (and its importance); population-distribution analyses.
Concentration versus dispersion relevancy in movements of inventory: importance of transport costs; geographical postponement; and control over the market (availability and some hint of power).
Comparative cost ratios and response times for production and distribution came to the fore - and a call for their differentiation.
Emergence of customer satisfaction and focus on cost efficiency.
Explanation of postponement of speculation.
Changes in the high street shop profile; supply chain; and power.

Table 11.2 The Industrial Years Historical Comparison of Military Vs Commercial Logistics, 1800 to 1970

i.e. railways and steamships - and as a central energy source for factories/mills. On the transportation front both military and commerce together, in parallel, exploited the benefits that the steam engine brought to provide mass transit of people/soldiers and to carry large and heavy loads over long land/continental and ocean/sea distances with speed. With the advent of such transportation and by utilising a 'campaign inventory structure' supported by 'supply trains' for particular wars/campaigns, the military showed signs of performing 'spatial integration'. Later, of course, the internal combustion engine revolutionised land travel further by offering 'door-to-door' service with land accessibility almost anywhere. The aeroplane brought about faster global travel for freight and passengers/soldiers; and for the military aerial warfare commenced. The development of aircraft was conducted jointly, but evidence exists pointing out that today, there is a divide occurring between commercial and military aerospace aspects. This should not be too surprising as jet fighter/strafing aircrafts are significantly different to pasenger airliners. However, there probably is some similarity (and some useful exchange of knowledge/learning could take place) regarding freight and heavy-lift aircraft.

Medical care and hygiene practices were originally developed in unison for military and non-military, but eventually the military established their own medical corps/units. (Evidence exists indicating that the Romans considered hygiene to be very important and in the remains of their fortresses, medical centres or mini-hospitals/surgeries have been found.) So medical aspects progressed together at first and then diverged, but any developments in modern medicines/drugs/pharmacology are shared for the mutual benefit of all concerned. Initially, the military probably sponsored and led the field in developing food preservatives and dehydrated foods to enable their compactness for transportation, storage and extended shelf-life until economic refrigeration evolved. The use of these for expeditionary pursuits was then developed and further coupled with novel developments like water purification tablets and 'vitamin-meal-tablets' (as used by astronauts today when in orbit or on a space exploration mission).

Variety has long been known to create problems with aspects like scheduling and utilisation; the military has tried to reduce the effect of variety by standardising. The Romans started standardisation by having trained legionnaires to erect/build/construct a 'rectangular legionary fort' according to a set design, method and materials, at the end of a day's march in hostile territory. After the problems caused by soldiers/personnel having too many different personal weapons in the Mexican War (1846-1847), whereby supplying the multitude of different calibre ammunition caused major headaches, the US embarked on a standardisation of pistols/rifles and their calibres. During the American Civil War, the South were greatly impeded with their railway transportation because of the problems caused by having too many different gauge tracks; the North had a standardised gauge throughout which, in comparison, proved very advantageous. The UK Army is currently studying the possibility of using only *one type* of liquid

hydrocarbon fuel for all its vehicles, power generating equipment and other utensiles; thus hoping to remove all the current combinatorial problems, mistakes and contamination caused by having to hold/stock and supply many different fuels in various grades. Industry has generally preferred to minimise variety in favour of 'long run manufacturing' whilst marketing personnel protested on behalf of the consumer who wanted some choice/options/variety etc. From the 1960s onward, it has been possible for industry to provide a degree of variety, having had the concepts and arguments of 'postponement versus speculation' explained/detailed. In the past, there had been a mutuality regarding variety between military and business, but the current trend seems to be: the military is seeking more/greater standardisation(s); whilst commerce is trying to accomodate consumers by extending its offerings via *mass customisation*, where upstream standardisation is sought, but designed downstream diversification is preferable. Thus, there was a move from a position of logistics coincidence, to one of semi-divergence between the two sectors.

Both sectors have always had common interests in making material handling easier, faster, safer and less expensive. The military led the developments in this area by sponsoring and pioneering concepts like pipelines, palletisation, containerisation and other mechanical handling systems like DROPS. Business has adopted these quicker and 'economies of scale' methods of material handling - thus showing a convergence in this aspect.

During WW2, the military instituted the 'Requisition System' (which is now labelled as a 'pull system') for material supply/flow. Prior to this time, generally both sectors used/followed a 'push system'. Today, both sectors will claim that they operate 'pull'; however, in reality both sectors utilise a combination of 'pull' and 'push'. For material flow methodology the two sectors are coincident or in parallel (but the military took the lead regarding 'pull').

Computers, were developed and used by both sectors for conducting tedious calculations, complex mathematics and operational research studies - parallelity existed here.

In all probability, the most important item for the military has been, and is, communications. From the telegraph onwards, the military had encouraged, sponsored and assisted in pioneering all forms of communications: from early field telephones, through early radio, UHF/VHF radio, secure telephone, CB radio, Tac Data Transmission (TDT - encrypted Fax.), to close cicuit television (CCTV), etc. Commerce/civilians has/have benefited by these inventions and those that were needed were adopted/used by non-military: commerce; police; security; and emergency services, etc. There has been convergence here, but the military had (and still has) the 'leading edge'.

11.2.3 The Information Technology/Systems Years - Post 1970

Again, to facilitate an analysis and to demonstrate convincingly the comparative aspects, Table 11.3 was compiled which contains the pertinent data elements since 1970. The discussion of the more prominent elements follows now.

Logistics outsourcing in commerce/business has been growing since about the mid 1970s, brought about by the 'concentrating on core skills' message broadcasted by many management/business gurus. The results at first seemed quite good; however, during the mid 1990s its appropriateness is being questioned again. The military have bought-in logistics services of one type or another throughout history and it continues to do so. Following the MoD's Strategic Defence Review (SDR) Report of July 1998, many other opportunities for logistics outsourcing/contractorisation are being visited/revisted, sought and evaluated for the associated risks attached to each element. Naturally, the key question here is "how far *forward* is it safe for contractors to be allowed to go?" With regard to outsourcing the two sectors are rapidly converging.

Further communications advances sponsored by the military have been made with regard to better radio - Extra High Frequency (EHF) - aspects, improved satellite communications (e.g. Gobal Positioning System, etc.), real-time video conferencing and various *battlefield digitisation* programmes. The military are extremely well connected with communications with respect to military *strategy* and *tactics*. However, whilst the military stimulated a lot of the pioneering work for the evolution of communications that are employed in the commercial logistics field, the UK military, at present, does not have the logistics *connectivity* to the same degree as business (e.g. the whole IT/IS aspects associated with Quick/Rapid (Efficient Consumer) Response Logistics). (The author has some anecdotal evidence showing that the US military does have equivalent 'end-to-end' and 'state-of-the-art' technology 'screen-to-screen' logistics communications connectivity in line with modern business/commerce.) So, here appears a glaring gap between UK military logistics and business logistics - a major difference - *the level of connectivity with respect to logistics*. There is evidence available indicating that the UK military is conducting studies and has contracted consultants and software houses to assist it, and to offer it recommendations, for this position to be redressed/rectified. No doubt, this matter is heavily coupled with the outsourcing arrangements/questions/decisions mentioned previously. So, once the military logistics connectivity matter has been designed and installed, its total logistics will have a greater convergence to the business logistics, as it is currently being practised.

Present day professional exchanges about logistics between the two sectors are plentiful. Every conference, seminar and workshop on commercial logistics/supply chains/procurement that the author has attended (both for the purpose of this thesis and other self development) over the past 5 years, had at least one military or an MoD delgate.

Historical Evolution of Military Logistics:-

Wider use of commercial assistance/contracting in all areas.
GPS - Global Positioning System and satellite communications.
Advanced radio communications - Extra High Frequency (EHF).
Defence Satellite Communications System (DSCS) coupled with Jam-Resistant Secure Communications (JRSC).
Computer-based decision support systems - Gaming/Modelling.
OLIVER - Online Inventory Visibility, Enquiry and Request - world-wide visibility of all NATO held stocks, but batch up-dated.
VITAL - Visibility of Intransit Assets and Logging.
Real-time video conferencing.
Automated warehousing.

Historical Evolution of Commercial/Business Logistics:-

Systems approach to logistics designs and solutions.
Distinction between supply PUSH and demand PULL made/explained.
The whole panoply of factory inventory management and material flow methodologies MRP, MRPII, DRPII, JIT and OPT.
Inventory reduction and becoming information led.
Computerisation - simulations/modelling/logistics design.
Concepts of 'Hub & Spoke' and 'cross-docking'.
Strong focus on linking 'service' with logistics.
Outsourcing of specific service(s) or total logistics.
Relationships and trust between parties/partners.
International integration.
External integration.
GPS - Global Positioning System.
Partnerships, alliances in/with, and outsourcing of, logistics.
Leanness and supply base rationalisation.
Benchmarking and traceability throughout logistics.
Development of many mapping tools to analyse/design total logistics.
Unique item barcoding and computerised inventory/stock management.
Batch up-dating of computer data - moved to - real-time computer data.
EDI - Electronic Data Interchange and Logistics Information Systems (LIS) and general information sharing.
'End-to-End' optimisation and 'screen-to-screen' visibility throughout.
Quick/Rapid (Efficient Consumer) Response logistics.
Automated warehousing.
Radio data transmission in warehouses.
Reverse logistics ('Green') issues and sustainability.

Table 11.3 The Information Technology/Systems Years Historical Comparison of Military Vs Commercial Logistics, Post 1970

11.3 Update And Refinement Of Rider's Model

A good point at which to continue the comparison is with the Rider (1970:115) constitutive model/tabulation of "What is logistics?" From simple inspection, it has shortcomings. For business logistics the 'order processing' function was not included as a component part by Rider. Order processing is now widely recognised to be a part (or a component) of logistics, and even Stewart (1965:66) - published before Rider's work - had 'order processing' as one of his distribution system *activity cogs* showing their interdependency. Other literary support for this was quoted in Section 2.2.1 (page 21) of this thesis. Without exception, all the business case studies had order processing as one of their functions; all corresponding interviewees confirmed this too.

Additionally, part of the socio-economic function of business logistics these days is to reuse/recycle and reclaim materials. Rider had not included these aspects either; this was not surprising as the social and business environments have changed over the past 30 years; also, the 'green movement' was not as vociferous/active at that time. In the case studies C1, C2, C3, C4, C5, C6, C7 and C9, all collected packaging materials (carton, paper, brown paper and shrink-wrap) for recycling purposes. Also, C1, C2, C4 and C5 collected and reused clothe hangers. The case studies C7 and C8, reused wooden pallets; C7's were custom-made to size for their customers' metal plates/sheets purchases. Reusable trolleys and containers/crates were the standard practices at C1, C2, C3, C4, C5, C7 and C9. All business case studies claimed to be environmentally conscious and realised that the trend for the future was going to be more of such practices/ideas.

For the military side, in case studies M2, M3, M4, M5 and M7 the military did recover materials and equipment after their activities/excercises/operations. These were collected and returned to depots for inspection, repaired if necessary and credited back into inventory/stock for further reissuing; or, if severely damaged, disposed of in a socially responsible/acceptable manner. Examples of items that underwent such a procedure were: simulation ammunition (simmo) in M3; adventure training equipment, tentage, sand-bags, SA80 rifles and Land Rovers in M4; and various instruments and electronic gadgetry in M5. It became very clear that physical recovery (i.e. reclamation and/or reuse) was a socio-economic function which the military pursued/followed. Also, for all large (capital) equipment, in their 'life-cycle cost' budgeting stage/phase, provision was made to dispose of the 'end of life' equipment in a socially responsible manner - from M2, M6 and M7 (and *Disposal* being the seventh phase of the Downey cycle[42]).

The military logistics entity still has a wider brief with its work functions of

[42] The Downey cycle is a 'seven phase/stage' *project management* model/construct/procedure which the UK government insists its departments (and particularly the MoD) use/employ for capital purchases. The seven phases are: concept formulation; feasibility; project definition; full development; production; in-service; and disposal.

maintenance and *facilities engineering* and with its system processes of *requirements* and *conservation* aspects. Maintenance, facilities engineering and possibly conservation can be accepted as being somewhat exceptional to the military; but what about requirements? In military parlance, requirements are basically demands or a statement of need(s) (usually emanated from outside of the Logistics Regiment/Brigade) and it comprises the process of translating broad demands, or statements of need(s) received from any legitimate source, into specific logistics actions. Requirements are measured in terms of quantity, location and time (quality is also a criterion used especially in procurement). The translation process could be likened to the process of developing a business logistics strategy and plan that is compatible with a corporate strategy and, the rest is what industry would call large scale consolidation and consigning. Therefore, these do have similarities, although they are not perfectly the same.

Taking the above aspects and slotting them into the Rider model/tabulation (and substituting the word 'Transportation' for the term 'Traffic Management' used by Rider) resulted in Table 11.4 which produced a modified/updated and refined model/tabulation of the constitutive comparison of "What is logistics?"

With the additional elements added to Table 11.4 below and considering the functions employed by each sector, the similarities between military and business logistics become more convergent than was the position with the original Rider (1970) model (obviously, IT/IS are excluded). Certainly, it can be seen that military logistics encompasses all of the functions of business logistics. Although the updating/refining of Rider's work was interesting, in itself it is insufficient in scope and depth for such a study to be conclusive.

11.4 Data From The Case Studies

The trawled data from the case studies were categorised in the appropriate level of the conditional matrix (as shown in Figure 9.3, page 243). To demonstrate how the data levels/categories/elements/aspects were retrieved from the collected data, below are samples of quotes and facts together with the level aspect and category element that was attributed/ascribed to them:-

C1 interviewee said: "*... the pressure on costs in the retail side is extreme, we're always trying to squeeze money out of nothing, ...*" - Goal/Objective: Cost Reduction.

C1 interviewee said: "*... time compression is very extreme in the retail side at the moment as well.*" - Goal/Objective: Time Compression.

C1 books/reserves manufacturing capacity with respect to technical ability for fashion/clothing items such that their suppliers can change 'style runs/designs' in hours. - Strategy: Quick set-ups, i.e. achieving time compression.

C4 interviewee said: "*There is no money, and by that I mean margin, in transportation alone. We are always looking for opportunities to provide services in order to make*

Logistics as a ...	Business Function	Military Function
Set of Work-Functions	Procurement Transportation* Warehousing Inventory Control Order Processing	Procurement Transportation* Warehousing Inventory Control Order Processing Maintenance Facilities Engineering
Set of System Processes	Consolidation & Consigning Acquisition Movement Storage	Requirements Acquisition Movement Storage Conservation
Socio-Economic Function	Physical Supply Physical Distribution Physical Recycling/Reuse Physical Reclamation	Physical Supply Physical Distribution Physical Recovery

Items added to Rider's original Model/Table *Traffic Management was used here by Rider

Table 11.4 Modified/Updated Table of Rider's Constitutive Comparison of Business Vs Military Logistics

some profit." - Strategy: Offering services and seeking profit/margin.

General Manager of C8 said: "*... because product quality and price are not sources of long term sustainable advantage, it follows that the key differentiating factor on which we must focus, is SERVICE in all aspects.*" - Strategy: Service and service support.

C5 interviewee said: "*We are people of partners.*" - Strategy: To develop partnerships, good relationships, trust and commitment with their clients.

From M2, M3 and M7: When the government's policy changed to allow women to participate in the front-line activities/actions, both the item number/level and the inventory/stock holding increased noticeably in order to accomodate/sustain the women soldiers. The British Army now has in the region of circa 438 000 live items. - Strategy: Gender/Job equality resulted in the Characteristic: Larger stock variety (more stock items) and higher total inventory holding.

C1, C2, C3, C4, C5, C6 and C7 all have main surges at Christmas and Easter; Christmas is the biggest and spans for longer so it is planned for earlier. Seasonal sale-periods are usually small 'blips' in comparison. Minor surges occur all year round which were stimulated/exacerbated by specific events (sometimes self inflicted); some examples were: C5 had a surge for children's school clothing during late August and early September, just prior to the 'return to school' after the summer vacations. C1 had an instance of a strawberry advertising campaign which stimulated demand *way* above any expectation; and C7 interviewee said they had "*Give away offers.*" which heighten activity for those items whilst the promotion was on offer. - Characteristic: Surges some with defined periods.

C1 interviewee said: "*We sell products that range from selling one every hour-and-a-half to items that sell one every three-weeks.*" and "*Our annual volume/revenue pattern is consistent, the profile shape is similar year on year.*" - Characteristic/Pattern: Volatility patterns per product; and the peaks and troughs (i.e. seasonality) are known throughout the year.

C7 interviewee said: "*Our client was a knee-jerk operator!*" - Characteristic: Relating to surges, forecastability and speed, etc.

C1 interviewee said: "*Food products are more predictable than general merchandise, we can usually get the food forecast quantity within 10%.*" - Characteristic: Forecastability, with specific reference to new product introductions and known market behaviours (but applied generally as well).

C1 interviewee said: "*We are completely dependent on IT. No IT, no logistics!*" - Characteristic: Dependency on IT/IS.

From M4, M5 and M7 - a frequently used military quote was "*War equals Christmas!*" - Characteristic: Surge handling and management. (The quote refers to the known surge at Christmas that is faced by the business/commercial community.) Of course the date for Christmas is fixed and known - the military do not know so precisely when their surge handling/management activities will be required; because of this fact, the Army would like some logistics research into surge handling/management.

From E1 - It became apparent very quickly that many expedition logistics experts/gurus, authors, planners and organisers were ex-military/ex-Servicemen. - Characteristic: Many large scale, important and prestigious expeditions have their logistics planned, supervised and managed by ex-Service/military personnel.

E1 - Many pieces of advice were obtained in relation to planning and the setting-up of a logistics/supply system for expeditions. One piece of advice was *not* to set-up special logistics/supply systems unless there were no alternatives; the best first approach - and the least risk - is always to use current established supply systems. Only when these are not available should a bespoke system be inaugurated. Be careful/cautious of accepting donated supplies and/or equipment at the 'point of departure' - sometimes the cost of transporting such goods *is more* than the purchase of them at the 'point of arrival/use/need'. Also, for transportation over long distances in remote areas it is possible, and comparatively very cheap, to charter, or pay for, a local

Missionary light aircraft/airplane if one exists in the region. Interestingly, with respect to any gifts that are offered to tribes and/or communities that help/assist in any sustainment and/or study/research conducted - the advice here is *not* to give, or donate, too much or too expensive a gift/present to them, as this raises the expectations of the helping community when another research or study/expedition party wants to use their services and/or facilities next time. - Some Characteristics that lead to the Principle: The need for proper understanding, in-depth planning and cost control of expedition logistics.

From M6 - Provisional Irish Republican Army (PIRA) have many 'live/active' albeit 'dormant' bands/cells/gangs with their own operational cache of arms/equipment and the organisation in general probably has a few concealed/hidden (i.e. some underground) principal or 'mother' munition dumps in Southern Ireland. - Characteristic/Pattern: Network. Also - Principle: Proximity placement and geographical postponement.

C5 interviewee said: "*We have measures of everything; cost, productivity, quality and service.*" - Performance Indicators: Aspects that are measured/recorded.

C1 interviewee said: "*Partnerships, yes; but it's understood that we call the shots!*" - Concept: Power and control.

C3 interviewee said: "*Partnerships don't really exist, one party always seeks to maximise his gain. We work for our client, but we're so close to XXX, we're effectively part of them.*" - Concept: Power, control, and relationships.

From M3 - Some nodes were 'mobile nodes' (including mobile spare parts stores) and ammunition inventory deliveries were made via call-offs. - Principles: Mobile nodes in the military for both supply and use/point of delivery. Minimise excess to enhance mobility and speed.

C1 interviewee said: "*Having to prioritise items in logistics is an obsolete concept now.*" - Principle/Concept: Priorities do not exist, they are obsolete; standardised regular, accurate and systematic replenishment is the norm.

C7 interviewee said about his client: "*They pinch the best of what we do and grill us with the best they do!*" - Performance Indicators: Benchmarking/comparisons.

M2 interviewee commented: "*We have cut-back so much on our soldiers that with my quota off on training, the first level maintenance checks never get done. The equipment is not receiving the simplest of attentions!*" - Characteristic: Labour intensive aspects of first line maintenance and the shortage of manpower to carry it out.

From M5 - One of the principal objectives at this BOD was to reduce (i.e. minimise) the amount of cubic space being used, particularly in the automatic warehouse, by utilising the space in the stillages/cages better (i.e. to completely fill-up a stillage before starting to fill another). - Objective: To minimise cubic space used and to maximise space utilisation in stillages/cages. - Performance Indicator: Cubic space and its utilisation. - Dimension: Cubic capacity (m^3).

(This Depot used the 'three points dispersal' storage philosophy; and notably, the

AA size Manganese dry battery (UM-3) is the most requested/ordered item from this Depot.)

Some other interesting and noteworthy data peculiarities that emerged from the case studies were:-

C1 - Whilst conducting this case study the military (i.e. Army) had attachments from Donnington BOD and the Catering Corps to see and learn how they (i.e. the business sector) were conducting/practising logistics. Proof in itself that the military were seeking transferable knowledge, principles and concepts from the business and commercial sector. (This exercise *could have* also provided some data/information for process and/or generic (or best practice) benchmarking purposes?)

C6 - From analysed EPoS data collected at their stores (plus some other market research) came the revelation that people bought, and owned, four times as many 'tops' as 'bottoms' - i.e. for every pair of jeans/trousers or skirt sold the purchaser, potentially, would buy four tops. From this analysis, Levi Strauss changed the layout of their shops; originally the front part of the shops were decked out with the 'jeans' (i.e. bottoms) and, the tops (shirts, T-shirts, polo shirts, blouses, etc.) were at the back of the shops. The layout of their shops today is for the tops to be displayed at the front of the shops for opportunity impulse purchase sales and, the bottoms are now located on shelves at the rear of the shops. They claim that shop losses due to *shrinkage* have reduced as well because the potential shop-lifter has to penetrate deeper into the shop before getting to the more valuable merchandise, thus deterring the 'grab and run' opportunist. Also, Levi has recently introduced a tailored jeans service and these customers will receive a personal product/customer barcode, i.e. a unique customer-product specific coding.

All commercial cases - The idea of priority rules, or having a *priority system/arrangement*, is considered to be an obsolete practice. With communicative real-time electronic data transmission systems in place, coupled with responsive procedures, flexible processes and team/relationship approaches, the standardised regular, accurate and systemic replenishment becomes, and is, the norm.

From M3 - The material/materiel supply was a 'pull' system, i.e. via 'call-offs' from the Divisional Support Area (DSA) to downstream Close Replenishment Groups. But the incoming supply to the DSA was proximity placement (or geographical postponement) - some analysts may (and do) refer to this incoming supply to the DSA as a 'push' system rather than the '*dumping*' or '*pre-positioning*' that the Army carried out. (The author considered this to be geographical postponement.)

From M3, M4 and M5 - The buildings/storage sheds at the Military Depots were designed, planned and constructed to be set distances from each other in accordance with the Explosives Storage Regulations (ESRs) - not because these depots stored explosives (in fact they did/do not) but as a precautionary measure - so that, should these depots be bombed by enemy aircraft, hopefully, *not all* of the buildings/sheds

would be annihilated. This aspect, coupled with the 'three points dispersal' storage policy means that efficiency, in the operations as a whole, suffers. This efficiency debit is accepted as a minor drawback for the greater insurance measure that it offers/allows. (This differs from a commercial layout/design that would seek 'minimum material travel distances' and 'close coupled added value' processes; but, *split* commercial locations/sites exist as well, that have a similar inefficiency.)

M4 - Until the recent past, details and accounts of costs only were (and still are) collected by the Army solely because they are underwritten by the public purse and as such, they are accountable to parliament for their *spend.* As part of government's new initiatives it is now part of the MoD's remit to work to/within allocated budgets and to seek savings by employing cost effective methods and processes. Therefore, the cost and accounting data is now being selected and analysed *deeper* for complete understandings to seek *signposts* for savings and improvements in performance.

M7 - During peace time, a very large proportion of the Army's annual logistics operational budget was spent in moving house for their soldiers - and their families - to new quarters because of the change in (world-wide) postings. A big percentage (if not all) of this moving was contracted out to civilian organisations/enterprises.

M7 - A question frequently asked of the author by military personnel was: *"What is the difference between supply and support?"* The answer given was: "Supply is purely to do with material flow in response to an order/request be it consumable or durable, and when it had reached its destination 'the supply' was finished until another order. Support is the case when resources other than material are needed as well, or instead; like the maintenance of a helicopter may require a spare part - its delivery is supply, but to fit the spare part on the helicopter takes another resource, i.e. a fitter, mechanic or soldier - that is support."

E1 - From a lecture[43] given at the Royal Geographical Society (RGS) the *real* expedition mortality ranking differed considerably from the *romantically* perceived expedition mortality ranking: see Table 11.5. From Table 11.5, it can be seen that the predominant aspect of expedition mortality is road traffic accidents (RTAs) and this compares with the two army accidents (of which the author was aware) that occurred in the case study M3 specifically - fortunately these two were not fatal; similar evidence was found in M2 (and at least one fatal RTA was recorded in/from the Gulf War of 1991). Also, the fifth ranked cause is infections (which equate with diseases) and throughout history diseases were the scourge of the military (see Chapter 3).

E1 - Royal Geographical Society (RGS) grants and/or sponsorships for expeditions are not awarded until three aspects are defined and satisfied, viz: (i) the purpose of the expedition; (ii) the scientific methodology to be employed for the study and; (iii) the development and existence of a credible logistics plan to sustain/support the expedition.

E1 and Army Adventure Training - Interestingly, the army adventure training/sporting

43 Prof. David Warrell - Centre for Tropical Medicine and Infectious Diseases, Oxford University, in his lecture at the 'Expedition Logistics Conference' held at RGS on 18th/19th. November 1995.

EXPEDITION MORTALITY CAUSES RANKED	
Perceived	Real
Infections: (Lassa Fever, Yellow Fever, Rabies, Plague). Venomous Bites, Stings. Attacks by Animals. Cannibals. Sun Stroke.	Road Traffic Accidents. Drowning, Falls and Other Injuries. Altitude, Heat Exposure. Homicide. Infections (Malaria, AIDS, etc.).

Table 11.5 Expedition Mortality Ranking - Perceived Versus Real

categories coincide with the environment used for expedition classifications; they are: desert; tropical forest; polar; mountaineering; caving; underwater; and rivers (i.e. canoeing and river-rafting).

An example of a data sheet produced from a case study analysis is shown in Table 11.6; it is the corresponding analysis sheet for case study C5. The resulting data sheets of all the case studies are in the Appendices - Chapter 14 (commencing on page 341).

From all the individual case study data sheets (like Table 11.6) the component data elements were then transferred to four category specific and ordered comparative data analysis tables, where the military/expedition and business/commercial groups of data could be compared and contrasted. These category analysis tables will be discussed now.

11.5 Analysis Of The Case Studies

In order to compare the data and make analysis easier, a tabulation design was instituted whereby the sectors (i.e. military/army and expedition versus business and/or commercial) were listed side-by-side and the elements were entered into their sector's block in an arranged comparable order. Data elements, when transferred from the data sheets to the analysis tables, were accompanied with their source case study codes (for traceability). The applicable case study codes for each element were placed in parentheses following the element description concerned. Also, as a *cut-off* or *divide* between the similarities and the differences of each sector - a horizontal line - was placed across each sector's half such that the elements above the line were similar - i.e. the elements were found, or considered, to apply to both with no fundamental difference - whereas the elements below the line were designated fundamentally different from each sector - i.e. they do not apply to both and *may* be unique to its sector - (see Tables 11.7 to 11.10

Findings and Analysis Sheet from **Case Study C5:-**

Goals/Objectives:

To seek cost reductions (to add value not costs) and to establish the logistics cost per garment/good.
To provide a high level of service.
To seek time compression.
To reduce stock - seeking to be stockless.
To successfully complete the combining/integrating of the Mothercare distribution facility into BhS site.
To minimise risks.

Strategies:

Knowledge of their partner/client - customer/client obsessed - (people of partners).
Use their own software - they want to own the information.
The use of appropriate new technologies (IT and automation) if economically viable/feasible.
Education of suppliers.
Have an open and honest relationship with client/customers and suppliers - minimise surprises.
Have managers who are educated in, and understand, logistics.

Characteristics:

The client (BhS and Mothercare) dominates - has power and control over the supply chain/network.
The site (fixed assets) were owned by Storehouse Group - owners of BhS and Mothercare.
Christmas and Easter were the big peaks (Christmas the biggest) - small peaks were Bank Holidays and late August/early September when children go back to school.
Replenishment needs were greater at the end of the week rather than early week - the weekend spend.
Much computerised operational tabulated, graphed and histogrammed data.
Whilst having an automated sortation facility, the site is still labour intensive.

Principles/Concepts:

Single national depot/sortation/composite/cross-docking centre for both BhS and Mothercare.
Inventory owned by themselves - the logistics service providers - i.e. Exel logistics.
Neutral cash flow arrangement - they pay suppliers in 28 days, their client pays them in 14 days; the difference is what finances the stock.
Standardised procedures and common IT/IS arrangements throughout the supply chain/network - multiple links - distribution of appropriate data to parties - electronic visibility.
Analysis and understanding of the possessed data to obtain true benefits, reduced time, add value and reduce costs.
Not all suppliers have direct link access to sales data - for technical and trust reasons.
Some consigning done for stores at the suppliers - cages/trolleys received allocated for stores.
Unique product and container barcoding used - full scanning equipment etc.
Daily - 24 hour - replenishment.
Communications, speed and relationships.
Training/education and versatility of employees. Carton recycling.

Performance Indicators:

Distribution costs as a % of Sales.
Product availability. Fulfilment of store stock replenishments.
On-time deliveries.
Productivity; quality; costs; and service. Training/education and staff versatility.
Fleet utilisation (used for collections from suppliers too, i.e. shared cabs/trailer assets) and number of deliveries.
Intake margin is known, but the logistics impact on the intake margin is not known.
Picking accuracy, invoice accuracy and inventory accuracy.
Vehicle space utilisation.

Dimensions:

Costs (£).
Value (£) and volume/quantity of stock/inventory (number off of each item).
Time (hr).
Distance (km).
Space: area (m^2); and cube (m^3).
Headcount (number of people).

Table 11.6 Data Levels and Elements from the C5 Case Study

below). In the text below, a data element that is similar in the two sectors is indicated with a '+' at the start (i.e. a positive match) and, a data element that is different in the two sectors starts with a '-' (i.e. a negative match).

11.5.1 Comparison Of Characteristics

Table 11.7 contains the consolidated military/expedition and business logistics' characteristics from the 17 case studies. Common to both are:-

+ In all the case study visits, security at the sites/venues in question was high/tight for both military and commercial. The security checks were conducted upon all individuals going in and out as well as the vehicles (trucks and cars) driving in and out.

+ The case studies conducted/chosen were comparable large scale operations and from an analysis of the demand levels and patterns that they faced, both sectors deal with fluctuating demand patterns and levels.

+ The power over the supply chain/network seems to be held at the customer/user end of the system, i.e. with the front-line(s) of the Army and with the high street retailers and/or customers.

+ Communications are such that all the soldiers/employees are aware of what is required and the reasons and purposes are made clear. If there are any specific aspects that help people to understand the rationale for certain courses of action, or issues/matters, these are shared. Messages generally centre around the need for: cost reductions; time saving ideas; quality matters/issues; and the strategic importance of responding with the appropriate service flexibility and attitude.

+ Both MoD and the business organisations in general (i.e. the customers/clients) being served with logistics that were used for the case studies, had huge purchasing power.

+ Whilst the MoD owned all of its depots, not all of the depots on the commercial side were owned by their ultimate customer/client. A whole array of arrangements were found on the commercial side: from client owner and managed; through client owner but outsourced managed; to outsourcer owner and managed (but here there were usually contractual safeguards) - arrangements/schemes were tailored according to the clients' circumstances and preferences. This element was classed as a similarity between the two sectors because the MoD has formed, and moved towards, agency managed depots and multi-modal transportation/distribution (i.e. ABSDA - Army Base Storage and Distribution Agency, but as from April 1999 this becomes DSDA - Defence Storage and Distribution Agency with a tri-Service (i.e. purple) responsibility; and DTMX - Defence Transport & Movements Executive - again from April 1999, by combining with the Air Movements Executive and the Joint Transport and Movements Staff they will form a single (i.e. purple) Defence Transport and Movements organisation with responsibility for land, sea and air movements) and, in the future these *may* be privatised? (A depot that has been formed into an Agency for tri-Service support is the Medical Supplies Agency (MSA) at Ludgershall, Wiltshire, which has road and rail connections.) Also, various arrangements/schemes existed for Land Rover spare parts supply to the military (see the

Military and Expedition Characteristics:-

Scale and demand (volatility) levels vary/change, thus operational intensity and response levels vary accordingly. (M1, M2, M3, M4, M5, M6, M7, E1)

Medical support has to sustain injuries (combat and accidents) and diseases/illnesses. (M1, M2, M3, M6, M7, E1)

Clear 'vision' and purpose/objective known/communicated to all. (ALL)

Communications and appropriate transport (and its accessibility) are/is fundamental. (M1, M2, M3, M4, M5, M6, M7, E1)

Front-line(s) are the 'customers/clients' and they hold sway/power. Also, MoD has huge purchasing power. (M1, M2, M3, M4, M5, M6, M7)

All depots are MoD owned (with vertical integration downstream) and some stocks in them are very old, possibly obsolete. (M3, M4, M5, M7)

Most of inventory/stocks is/are owned by MoD - with some outsourcing.

Manpower (and any other resource) shortages/limitations impacts what can be done and, choices have to made about what is not done? This has the effect of stimulating alternatives. (M1, M2, M3, M6, M7, E1)

All sorts of material handling capabilities are available for use including some automation. (M1, M2, M3, M4, M5, M6, M7)

Heterogeneity of items handled/transported - people too. (ALL)

Road and rail links/connections at depots. (M3, M4, M5)

Good relationships and people throughout knew each other. (ALL)

The amount of each stock/inventory (i.e. quantities) to hold (or should be held) is very difficult to decide. (M2, M3, M4, M5, M6, M7, E1)

Enemy will interdict and steal/damage supplies. (M1, E1)

Women soldiers/expeditioners are now very prevalent. (M2, M3, M7, E1)

Accidents happen. (M2, M3, M7, E1)

Data capture was primarily manual. (M1, M2, M3, M4, M5, M6, M7)

24 hours/day & 7 days/week sustainment & operations. (M2, M3, M7, E1)

Embedded 'mind-set'/culture may be a problem (will have to be overcome) for change? (M2, M3, M7)

Delivery points/destinations can be 'mobile nodes' as well as fixed points. (M1, M2, M3, M4, M5, M6, M7, E1)

Maintenance/repairs are part of the logistics 'umbrella'. (M1 - M7)

Provision of hygiene facilities/aspects for people. (M2, M3, M7, E1)

Triangle of inventory, repair and movement is central to function. (M1 - 7)

All ground topographies/terrains are encountered. Very often, the infrastructure has to be established/set-up. (M1, M2, M3, M6, M7, E1)

All types of environments are encountered; hence efficiency debits. (ALL)

Many authors, and planners of expedition logistics are retired/ex-military people. (E1)

Commercial/Business Characteristics:-

Demand patterns/volatility/variability occurs, but there are some defined high levels, e.g. weekends; seasons, Christmas; Easter, etc. (ALL)

Customers are classified into three categories: 'partner'; 'delegator'; and 'order giver'. (C8)

Demand is excessive and is not being met - a supplier capacity issue. (C6)

Price competition was the biggest obstacle and service is being used to help differentiate the 'bundle' offering(s). (C8)

Communications - all types - throughout, seen as essential. (ALL)

The retailer/client/customer/user end of the supply chain/network has the power. (C1, C2, C3, C4, C5, C6, C7, C8, C9)

Conglomerates have huge buying power and sway. (C1, C5's customer, C7's customer, C8)

Depot ownership: C1, C6, C8, and C9 own and manage their own depots; in C5 and C7 the depots are owned by their clients; and C2, C3 and C4 own their own depots, but contractually, the client has to/will buy the depot or compensate appropriately if he ceases to use them as service providers. (This element, and element below, are tailored.)

Inventory ownership: C1, C6, C8 and C9 own their own inventory; in C2, C3, C4 and C7 inventory is owned by their clients; and C5 owns the inventory temporarily as an intermediary. All had high item level.

Depot/DC work is very labour intensive. (C1, C2, C3, C4, C5, C6, C7, C9)

There is a service versus volume trade-off (given limited resources). (C3)

Retail goods handling is separated into: furniture; hanging and boxed; dry/ambient foods; chilled foods; and frozen foods. Road transported.

Many types of material handling is used includingmuch automation. (ALL)

Some appropriate automated material handling. (C1, C2, C4, C5)

Long association/affiliation/relationships between the parties. (C1, C2, C3, C4, C5's intention, C6, C7's intention, C8)

Client C1 supplies/loans the software to C2, C3 and C4; and the client for C7 does the same.

Errors grow (i.e. compound) backwards from retailer to supplier(s). (C1)

Due to strong 'branding' there is a high risk of pilfering/shrinkage. (C6)

Much computerised data capture and electronic/automatic transmission systems. (C1, C2, C3, C4, C5, C7)

Accepted philosophy that change is inevitable and that flexibility is key. (C1, C2, C3, C4, C5, C7, C8, C9)

Fairly wide use of benchmarking. (C1, C2, C3, C4, C5, C7, C8, C9)

Transport costs are well managed in general and other areas are sought for cost reductions.

Table 11.7 Comparison of Characteristics

next element/item).
+ Similarly, the MoD owns most (nearly all) of its stocks/inventory. The MoD has outsourced the spare parts supply for the Army's Land Rover fleet, where the Service Provider - Unipart - complies with two systems simultaneously: (1) For the Northern Ireland fleet (i.e. M6) the MoD owns the inventory and the Service Provider is paid a fee to hold the parts and to supply/deliver them as requested and; (2) For the rest of the Army's Land Rover fleet (say, for the contingent in Cyprus) the Service Provider owns the inventory until the Army effectively *orders and purchases* it/them for its needs/use, when the Service Provider will deliver it/them. Most of the commercial enterprises - for whom the logistics system(s) worked for ultimately - owned the inventory in the chain/network except for one arrangement (i.e. C5) where the Service Provider purchased and owned the inventory for a short while (usually for two weeks), but this was by what they called a 'cash neutral' arrangement. So, both sectors use single transfer of ownership of goods/materials/products and, multiple transfers of ownership of stock.
+ The work carried out at depots (and intermediate nodes like Immediate Replenishment Groups (IRGs)) is very labour intensive for both sectors. This situation has the effect of stimulating alternative ways of doing things (i.e. DROPS) with the recognition that there is a volume versus service trade-off, given that there are limited resources.
+ Both sectors have an array of material handling facilities - some purpose designed and some automated - appropriate to the needs and circumstances. The commercial sector is working on the development of a multi-compartmentalised (i.e. various (3 or 4) temperature zoned) vehicle so that one vehicle can carry the whole panoply of a store's consignment to make one delivery only, rather than the present 3 or 4 different vehicles delivering the three food temperatures and 'packaged' (i.e. hanging and boxed goods) products separately. This will remove the costly homogeneous type '4 visit drop' (or 'multi-visit drop') to a store, and replace it with the more 'store friendly' service and efficient heterogeneous 'one visit only drop' at each store; there may be 'Green' benefits.
+ All the transportation observed by the author in both sectors was via road. However, all the military depots have rail connections too. (It is a known fact that many of the primary/raw material producers (and other commercial enterprises) have rail connections on their sites, viz: oil refineries; steel mills; coal mines; power stations; etc.)
+ Throughout the case studies in both sectors relationships were very important. The relationships observed in all the military case studies seemed to work well primarily because everybody knew each other and everything was conducted in an informal manner; they worked with a very high degree of personal *contactivity* both within nodes and between nodes - bearing in mind that what was studied in the army/military cases amounted to a vertically integrated operation. Whilst in the commercial sector, relationships were talked about and the emphasis was on good, cooperative, information sharing and partnership style/type relationships, the contactivity level was not observed as much here between nodes, but it did exist within nodes. The third party, outsourced or contracted logistics providers and their clients, did have associations of very long standing and were part of a jointly developed system. Two of the commercial clients in

this study actually supply the computer software for the operations to their third party partners; this ensured compatible communication - i.e. *connectivity* between nodes. In the profit centre C8 case, the long, happy, flexible, cost efficient and cost effective association with its private owner/driver lorry fleet was being mourned because the parent company had negotiated a company-wide contract with an outsourced provider; C8 was soon to give-up the private lorry owner/driver fleet which was the lowest cost transport throughout the national enterprise - a kind of sub-optimisation. However, the new company-wide contract would result in cheaper total transport across the whole - i.e. total transport cost optimisation - in spite of the fact that for the C8 centre itself, its transport costs would rise.

+ Stock holding quantity decisions are difficult; there is a probable tendency to err on the safe - i.e. sufficient insurance - side. (An interesting anecdote, from a soldier with whom the author once had lunch, was how during the Gulf War of 1991, the soldier had ordered 4 batteries and when they arrived, he had received 400 batteries - a factor of a hundred difference.) This is also true for the commercial entities (unsold stocks), who are aware of the error compounding backwards in the chain/network (but, with the electronic connectivity and real-time data in businesses, this phenomenon is being alleviated).

+ For the military, it is considered normal that an enemy will target the destruction of supplies or, requisition/steal them for his own use/purposes. Usually, during wars, because there are shortages of most things, a vibrant 'black-market' develops. In business, goods, particularly strong 'branded' ones, are also stolen/pilfered because they are highly sought after and/or they can be sold easily on/in the 'black-market'.

+ The other common points are the fact that: women are becoming more prominent in all aspects of life - commerce and military; and road traffic accidents happen/occur.

Characteristics different between the two sectors are:-

- The data capture techniques are fundamentally different. In the military the bulk of the data capture is manual, whereas in commerce the bulk of the data capture is via barcodes, the status of which are read and transmitted electronically. Many of the commercial computer architecture and systems are *real-time* too, which means up-to-date information.
- The military have to be *totally* sustained/supported 24 hours/day, 7 days/week and 52 weeks/year which means a 'round-the-clock' continuous *complete* logistics operation. Businesses do not have to provide/offer that *entirety* of a logistics operation. (However, it is recognised that 7 days/week (and, possibly 24 hours/day) shopping <u>may</u> become the national norm in the not too distant future. Commercial logistics would then have to adjust and adapt.)
- The attitude of organisational change and the acceptance of restructuring is far more readily embraced within commerce/business these days. Within the military, 'mind-sets', culture, the traditions, functional and *empire* bases and cap-badge loyalties are stumbling blocks to appropriate restructuring and organisational compatibility. (The author must add here that these findings were not an impediment to 'what had to be done' in a 'real action' circumstance. The finding seems to be a peacetime congealment. However, these

coagulations are beginning to be broken-down.) Many derogatory remarks were heard by the author regarding the interface between military and civilian personnel working at the same location for the same purposes and doing similar jobs/works - remarks came from both sides. (However, when questioned about how this interface was detrimental to *real action*, the response was: "Not at all!" In fact interviewees confirmed that during the Falklands - 1982 and Gulf - 1991 campaigns, the civilian employees performed as ideally and beneficially as was possible, indeed, to all intents and purposes, outstandingly.)
- The military in action and expeditions can have mobile nodes to which supplies have to be delivered. None such mobile nodes were found on the commercial/business side.
- Repairs to fighting equipment, assets and infrastructures are a key aspect of military logistics. These activities, whilst prevalent in the civilian sector, are not a part of business logistics. (Although many commercial distribution depots have truck/lorry maintenance facilities on-site (usually to do engine filter changes and *simple* works), however, a vast number have service contracts with specialists to conduct these maintenance activities.)
- Part of the military logistics function is to provide complete sustainment for its soldiers. This means providing - in the field - all the necessary food, hygiene/sanitary and medical facilities for both men and women, like: washing/bathing means; laundry equipment; toilets/latrines; field medical tents/surgeries; ambulances; as well as appropriate clothing and/or protection. This applies to a large extent in the expedition circumstance too. Such provision is not a commercial logistics purpose.
- The military and explorers/expeditioners, very often, have to establish/build their own infrastructure for their logistics, accesses and sustainment. Sometimes, the established or set-up infrastructure is for a temporary period only (and then it has to be dismantled) or, it is on a semi-permanent basis. As a result of the nature of battles/wars (and expeditions) all sorts of ground topography/terrain and environments are encountered, and these have to be overcome, by the military and explorers/expeditioners. By definition, this means that some 'efficiency debits' will be inevitable.
- Many of the experts on expedition logistics are ex-Servicemen/ex-military.
- The business sector is using benchmarking widely - although they are not too keen about sharing the data because of their belief/perception that it forms part of their competitive advantage/edge. The military are beginning to employ benchmarking but clearly, finding comparable scenarios is not easy. Internal military benchmarking between Services is perhaps surfacing, but, as one military person said to the author: "*Well, we talk a lot about benchmarking, but really we only pay lip-service to it.*"
- For the commercial sector, there is a belief that, in general, transport costs are very well managed and that the search for further cost reductions must come from elsewhere.

11.5.2 Comparison Of Principles/Concepts

For the comparison of principles/concepts, the following points are taken from Table 11.8. Aspects found common to both are:-
+ The in-depth planning, holistic view and bespoking/tailoring of logistics by

Military and Expedition Principles/Concepts:-

In-depth planning and bespoke/tailored arrangemnents by educated/trained people in logistics and who recorded past/present experiences. (ALL)
Allocation of resources to best advantage. (M1, M6, M7, E1)
Both home nation support (i.e. equipment/materiel from UK) and local purchases (i.e. fresh food); divergent, linear and convergent systems and 'hub and spoke' concept. (M1, M2, M3, M4, M5, M6, M7, E1)
Nodes with specific purposes (i.e. 'hub and spoke') and links. (ALL)
Some nodes are 'key decision points' (KDP). (M2, M3, M7)
Unique product identity via Nato Stock Number (NSN). (M2 through M7)
Good layouts: material and traffic flow; safety. (M2, M3, M4, M5)
Geographical postponement - 'dumping'. (ALL)
'One-stop-shopping/supply' concept and/or 'single point holding'. (M2, M3, M4, M5, M6)
Availability of both equipment and stocks/inventories. (M2 through M7)
Mobility and speed - DROPS and re-usable flat-racks; container handling and transfer equipment; smaller columns; etc. (M1, M2, M3, M6, M7)
Containerisation and associated handling equipment for multi-modal transfer/switching and minimise handling. (M2, M3, M4, M5, M6)
Outsource/contract haulage/transport. (M1, M2, M4, M5, M6, M7)
Relationships, people know each other and doing what is 'right'. (ALL)
Communications for maintaining contact and conveying information on needs/requests. (M1, M2, M3, M6, E1)
Supply smoothing (call-offs) and JIT concepts (i.e. pull). (M2, M3, M7)
Re-order point(s) used for most replacement of supplies/spares at depots and mobile nodes. (M2, M3, M4, M5, M6)
Unmarked cases/containers (not to publicise contents). (M4, M5, M6)
Computerised visibility of stock holding at Depot level location only; (this is batch up-dated). (M2, M3, M4, M5, M6)
'Flat-pack' concept, portability, ease of assembly/packing-up and handling; individually packed food(s)/rations. (M2, M3, M4, M6, E1)
Change management (culture change); organisation theory; and business management practices are needed. (M7)
Global supply of horses/mules; Uniform colour change. (M1)

Mobile nodes, both source and user. (M1, M2, M3, M6, M7, E1)
Inventory/surge buffer(s). (ALL)
Readiness and availability of equipment and people. (M2, M3, M6)
Priority system in place. (M1, M2, M3, M4, M5, M6)
Soldiers/individuals carry own survival accoutrements. (M1, M2, M3, E1)
Starvation and restriction of the enemy so as to reduce their accessibility to support/sustainment. (M1)

Commercial/Business Principles/Concepts:-

In-depth planning and holistic view, matching demands/requirements and much bespoke arrangements between client/service provider. (ALL)
Analysis and understanding of acquired data to obtain true benefits, reduce time, add value, improve service & quality and reduce costs. (ALL)
Fixed nodes with specific functions/purposes and links. (ALL)
'Hub and spoke' network consolidation/consigning concept. (ALL)
Unique product and container coding via barcodes. (C1, C2, C3, C4, C5, C6, C7, C8 (available but not used yet), C9)
Good layouts for material and traffic flow; safety. (ALL)
Use of postponement (geographical - depot proximity, packaging and/or added value). (ALL)
'One stop shopping' concept for item groups/categories. (ALL)
Product availability at the retail store. (C1, C2, C3, C4, C5, C6, C7, C9)
Matched containers/trolleys to product(s) to minimise handling, for speed, matched quantities and they are re-usable/returnable. (C1 to C5)
Recycling of packaging; returnable/re-usable containers/pallets, etc. (ALL)
Outsourcing is prevalent. (ALL)
Relationships (internal and external - paying on-time, information). (ALL)
Quality and service. (ALL)
Once a day (24 hr) 'pull' replenishement. (C1, C3, C4, C5, C7)
Call-off arrangement. (C2, C6, C8, C9)
Re-order point(s) used for depot replenishment. (C8, C9)
Unmarked lorries and boxes/containers - not to advertise contents. (C6)
On-the-job (OTJ) training and education of the workforce at all levels. (C1, C2, C3, C4, C5, C6, C7, C8, C9)
Versatility of labour, no demarcations. (C1, C2, C3, C4, C5, C6, C7, C8)
Whilst running a job, the next job will be setting-up (outside work) a form of parallel processing. (C8, C9)
Shared assets (cabs & trailers, etc.). (C1, C2, C3, C4, C5, C7)
Some stores' consigning done at the suppliers prior to depot/DC. (C5)
Deliveries to stores outside of store opening times wherever possible; the concept of 'delivery windows'. (C1, C2, C3, C4, C5, C7)

Speed - real-time systems, electronic data capture and transmission. (C1, C2, C3, C4, C5, C7)
Computerised visibility of real-time data throughout chain/network. (C1, C2, C3, C4, C7)
Priority rules are obsolete: standardised regular, accurate, systemic replenishment is the norm. (ALL except C6 and C9)
Culture of change (its frequency and speed). (ALL)
Shop layouts changed due to EPoS data, and personalised barcode. (C6)

Table 11.8 Comparison of Principles/Concepts

qualified/experienced people are common to all sectors. For the military and expedition scenarios the arrangements/infrastructures may be of a temporary/semi-permanent nature because of the call at the particular time or circumstance. For business, the planning and whole perspective aspects are conducted at a strategic level to set-up the infrastructure with a rigorous permanency for a reliable repeatability of operation.

+ All the evidence in every case indicates an approach to operational logistics that would employ the resources to the matching of customers' demands/needs/wants with best advantage to the operator(s).

+ Nodes and links analysis is a feature that can be applied to all sectors. (N.B. Basically, downstream of Base Ordnance Depots (BODs) what was observed in the military compared favourably with a vertically integrated enterprise.) All nodes have specific/designated purposes; in fact, for the military some nodes are denominated 'key decision points' (KDPs); these are a direct parallel to what commerce/business calls a 'focus (or focal) node'. The business side only possesses fixed nodes. 'Hub and spoke' arrangements with convergent and divergent logistics are found in both sectors and, linear logistics is also common to all.

+ Unique product coding or identity at the item level is used by both sectors but, of a different kind. The military use a 13 character alphanumeric code called a Nato Stock Number (NSN), whilst the commercial enterprises use barcodes. There is a further difference here in that barcodes are used by businesses for stock keeping units (SKUs) and container identity as well; no such similarity exists in the military with the NSN.

+ In all cases node layouts are designed/planned for both material flow and traffic flow; i.e. for logical sequence, safety related, and best/optimum use of space available.

+ Geographical postponement is employed widely by both sectors. Packaging and added-value/assembly postponement are also employed by both sectors.

+ The concepts of 'one stop shopping' and 'single point holding' is a feature that both sectors make use of extensively.

+ Availability is a concept which is used by both sectors. The military seek availability of both inventory/stocks - like war maintenance reserves (WMR) - and equipment which can be calculated two ways: equipment availability (i.e readiness); and mission availability (i.e. dependability). For commerce, the concept is to have an article/item available in the retail store (i.e. on the shelf) so that an opportunity to sell that item is *not* lost.

+ All participate in giving thought to the appropriate design of facilities that minimise handling, reduce time in the process (i.e. speed) and the matching of dispatched quantities to the actual demand, even if the amount is 'one'. Many of the trolleys/pallets/containers/flat-racks are returnable and re-usable. Recycling of packaging (particularly carton) is considered the norm these days.

+ Outsourcing, whilst very common in the commercial sector for many tasks, is employed in the military sector too - particularly for haulage and transportation, but also for Land Rover spare parts, etc.

+ Developing good relationships and sharing information is considered crucial in all sectors. As mentioned under characteristics, the military have a greater human

contactivity for communications, which are predominantly internal (vertical integration downstream of BODs) and also have excellent radio facilities for field communications. On the commercial side, the relationships are predicated on good business interactions/practices and are established at the outset of a 'partnership' with a shared strategic outlook that involves commitment, mutuality and usually the integration of the communication/transaction computer technologies of the purchasing company with that of the supplier, i.e. connectivity, 'screen to screen'. In business internal communications are equally cogent and this is ranked high on management's priorities; especially, in conveying to their employees the concept of how important the customer is and that satisfying and servicing him properly - with speed, accuracy, high quality, low cost, responsiveness, the right attitude, pleasantness, agility and above all flexibility - is crucial for continued employment and longevity of the trade partnership. All the above points are predicated on the 'two or more heads are better than one' principle to solution generation and/or problem solving. Furthermore, familiarity helps to institutionalise practices, processes, procedures and standards/quality in the chain/network.

+ Both use the 'pull' (demand led/driven) system concept and attempt to achieve supply smoothing via call-offs. Commerce, in the retail market, almost universally has a once-a-day delivery (i.e. every 24 hours (once/day) replenishment).

+ Re-order points are used quite widely. The military refer to these as 'minimum quantity levels' and then order some more.

+ The use of unmarked boxes/cases, etc. thereby not advertising/indicating the contents within is again used by both sectors. (Interestingly, at a conference, a delegate informed the author of his company Chairman, who had stated at a Board Meeting, that he would be quite happy for there to be less lorries/trucks on the road with the company's logo/trade mark upon them (in other words more unmarked lorries or, contracted lorries). The rationale for this was that the Chairman did not want the public to be attributing/accusing the company with/of vast vehicular pollution emissions.)

+ On-the-job (OTJ) training is prevalent in both sectors. Both sectors view this as a good and relevant way of developing competency in their people/staff via experiential learning.

+ Computerised visibility of stocks at the depot level is more or less a standard feature everywhere these days (although the military only has batch up-dated versions including the link-up with NATO). As a result of both the Falklands and Gulf campaigns, the British Army has invested in the development of a visual asset tracking system which has the umbrella name of GLOBAL, and the main part of it is called VITAL (Visibility of In-Transit Assets and Logging).

+ Versatility of labour/staff/soldiers and no demarcations (as far as trained personnel is concerned) have become a standard working practice now. Even the belittling remarks the author heard military personnel make about civilian staff - whilst probably true during training (i.e. no real risk) exercises - did not bear resemblance to reality during the *real thing*, when the Falklands and Gulf campaigns were in operation.

+ The 'flat-pack' concept, portability, ease of assembly/packing-up and handling are key principles in the military and for expeditions, coupled with the notion of individually (i.e.

per person) packed food and rations so that there is a minimium of waste. Although not covered by this thesis, the Do-It-Yourself (DIY) outlets sell much of their offerings in flat-pack form for the portability and ease of assembly purposes for their customers but, the main benefit of flat-packs (which is accrued by the supplier(s)/retailer(s)) is the considerably reduced volume or cubic space taken-up in their transport and storage. Also, to minimise waste and match the portions to their customers' needs, many supermarkets offer pre-packed food in many sizes and ranges, from small/single portions (for customers who 'live alone') through to various family and party pack sizes.

+ There was a recognition by the military senior officers that some of the business management practices in change management, culture change, organisational theory and other analytical tools can be of assistance to their making improvements.

+ Parallel processing, particularly in 'outside work' when setting-up process machinery for the next 'run', whilst very common in industry, is the norm for the military too. Repair works to military equipment are conducted whilst pool equipment or substitute facilities are being employed in their stead.

+ Many of the partners in the commercial sector share assets when necessary, particularly tractor cabs and trailers. This increases the utilisation rates of these and, possibly, if planned properly, reduces the total asset base needed for an operational set-up. Whilst sharing of assets by the military was not observed, the author is quite confident of the fact, that between the three Services, should it be necessary to share trucks/lorries, this would happen. Afterall, there are some *lead* tri-Service arrangements where one Service takes responsibility for the supply or purchase of something, or an aspect, for the whole of MoD. Examples are: the Army handles the ammunition procurement and their delivery/supplies for all three Services; the RAF handles the office furniture purchasing and procurement for all three Services; and much of the land based logistics - including aircraft maintenance - for the Royal Navy (RN) is conducted by the RAF. In addition, most of the Army depots visited for this research work, have stock items that they are holding for the other Services - particularly the RN.

+ As supply/distribution networks have been designed/set-up in businesses with distribution and/or composite depots as nodes, some consignments that they receive for onward transmission can be, and are consigned for its ultimate destination by the original supplier. The only job left for the depot to do is to cross-dock it (i.e. load it on (or consolidate it with) the next transport run to its ultimate destination). Whilst this was not observed in the military cases, the author feels sure that this arrangement is a feature that the military partake in also - particularly during real conflicts.

+ In the Boer War, the need for mobility offered by horses meant that the large supply of horses had to be sourced world-wide. Similarly, in the commercial world, should there be a shortage of a material, then the purchasers in companies would search the world for the supplies that they seek and, obviously, the economics of price variations according to supply and demand will apply. Likewise, when an army changes uniforms, as did the British Army during the Boer War, all of the same supply matters associated with it are faced by any commercial company that chooses to change the dress designs and colours

of uniforms for its staff, e.g. the styles/patterns and colours of stewardesses and other employees' outfits for an airline company, both ground and air crew.
+ The concept of a 'delivery window', whilst apparent in the retail world where delivery lorries have to arrive at a store within a specified time period, applies to the military too. Consider a military aircraft in flight with a scheduled air to air refuelling rendezvous so that it may continue its journey/mission without a landing; the aircraft may have limited fuel while it is waiting for the air-tanker to arrive and re-fill its tanks. Another example could be the 'meeting window' (and location) of a 'special operations' soldier/team to receive some supplies/information, etc. out of sight of, and unbeknown to, the enemy, in order to continue with the mission.

The non-comparable aspects of principles/concepts are:-
- The military have 'mobile nodes' both in the user (i.e. front-line(s)) and the source (i.e. like a mobile spare-parts *entourage*, a number of container store-rooms mounted on lorries/trucks). (Another example of a mobile node is 'air to air refuelling' (AAR) where the air-tanker has to find the fuel receiving aircraft (a reconnaissance point) prior to the discharging of some of its load.) In the business cases only 'fixed nodes' were found.
- In order to maintain the balance between *Readiness* and *Regenerative Capability*, for security purposes and peace of mind, the military have large stocks of inventory as part of a 'just-in-case' measure to be able to take action or respond immediately should the need arise, as well as for buffering (i.e. the lead-time issue associated with) the *ramping-up* of industry to re-supply once *action* has commenced. As an example of the inventory value held by the MoD, the three Army depots that formed part of the military set of case studies for this thesis, together hold an inventory value in excess of £2 x 10^9. The Army has many more other depots and, then there are the RAF and RN to take into consideration. For the business sector, one of the prime objectives is to reduce inventories, to approach as far as is possible a *stockless* supply chain/network.
- The military have terms like 'readiness' and 'availability' which apply to people too, like the 'Spearhead Group' - a company of soldiers that is on standby/designated for an *immediate transfer* to a prescribed trouble-spot should the need arise (M6). This company of soldiers is changed on a frequent periodic basis (like every 4 weeks - a roulement) because of the *high level* of readiness they have to maintain by being ready/available.
- The military have a priority system; it used to be colour coded for delivery as follows:-
From Bicester (M3) - the coded priority system was (the old system):-
Red ** = 24 hours; Red * = 36 hours; Yellow = 48 hours; Green = 4 days; and
Blue = 7 days. The British Army has now adopted the Standard Priority System (SPS) for everything (it was originally developed for spares) as explained by Southworth (1989) (and on pages 22-23 of this thesis) and, from M6, because of its *high operational status* the Northern Ireland Operation(s) has been allocated the SPS range of 01 - 04, i.e. all requests/orders (not just spares) are to be delivered within 24 hours. The SPS requires trust (and possibly a policing scheme) to work, as it is envisaged that abuse is inevitable. For commerce, the concept of priority rules is obsolete (in retail supply/replenishment at

least); the norm today is standardised regular - usually daily, accurate, systematic replenishment. Another military priority aspect assessed and handled by category management and/or category relationships is the obligatory (i.e. must) support - via primary equipment packs etc. - of those items of equipment and/or weapons designated "Mission Essential". (Clearly, for spare parts and other non-retail businesses, priority rules do exist in the commercial sector (and possibly the rescue services); these come under the heading of 'criticality' and price/cost then dictates (or encourages) the service level demanded, but they were/are not covered by this thesis.)

- Soldiers and explorers physically carry their own accoutrements - which often include survival aids. There is a kind of parallel in commerce when considering the company 'Rep' who often carries samples and demonstration gear/equipment, although usually he does not physically carry these - he has a car/van. Also, whilst the Rep may carry his sandwiches/lunch the survival aspect and the *climatic exposures* are not quite in the same category as the soldier, or explorer.
- Clearly, in a war scenario, starving and restricting an enemy's access to support and sustainment is a good and viable strategy, as the intentions are to weaken and demoralise the opposition thereby establishing an advantage. At first inspection, this appears a purely military tactic, but, although not covered by this thesis, in business a company may try to obtain/accumulate all of a certain scarce commodity/material/resource in order to 'starve' its competitor(s) of it and thereby gain a marketing advantage. However, this strategy can, and does, stimulate innovation by the competitor(s) to find alternatives and substitutes, but obviously a penalty time factor is introduced (again in the military case an enemy would/may improvise but the penalty time factor comes to the fore too).
- Probably the chief difference that was observed in these case studies is the amount of 'real-time' automatic electronic data capture (and *triggering*) and transmission via barcoding, laser/light pen/gun readers, EPoS and EDI used in the commercial/business sector. These offer speed, screen visibility at any terminal in the chain/network, no errors and can be analysed on-line for whatever information an organisation feels it needs to improve its performance. In short, full *connectivity* and with such a facility with *programmed-in* rules/decisions, the need for priorities becomes a feature of the past. This kind of link-up was not seen in the military case studies.
- The interviewees of the commercial enterprises used for this thesis claim that their organisations are formed of people who possess a culture which understands and accepts the need for change and, more importantly, the speed and frequency of such changes. The military recognises the absence of this factor in themselves and it has been highlighted as an area that warrants attention in their structure(s) and hierarchy.
- The commercial sector, with analysed EPoS data, accurately replenishes its stocks (sometimes with automatic ordering) and changes its retail shop layouts to best advantage.

11.5.3 Comparison Of Performance Indicators

Basically, the performance indicators found in this research, which are tabulated in Table 11.9, fall into the six categories of: productivity (including efficiency, capacity and utilisation); cost; speed/time; quality; service; and absolute counts. The following performance indicator data comparisons are taken from Table 11.9 and, starting with the similarities, they are:-

+ Physical availability of products/items/equipment: at the store for commerce; and with the front-line(s) for the military.

+ Order and/or consignment/consolidation fulfilment and replenishment rate.

+ Inventory/stock quantity and data accuracy of its make-up and content, including the classification and proportion of 'live' and 'non-live' items.

+ The condition/quality of the stock/inventory such as: damage free; protection; shelf-life (and FIFO process ability/operation) management; safety; etc.

+ Quality measures such as product protection packaging and inventory handling without damage. Also, correct/accurate addresses should be available to the dispatch/delivery people. There should also be accurate invoices in businesses for their customers to pay and accurate dispatch notices for the military for their *spend reporting* and *accountability* to parliament.

+ The inventory picking *accuracy* is a measure used by all. For the commercial replenishment cycles another measure used is 'proportion of items picked ahead of time'. In the military cases, although this was not specified as a performance measure/indicator, the principle was observed in operation, as often in the Army depots the author witnessed picked items at/in the dispatch areas/bays and, many hours later those items were still there - clearly these had been picked ahead of time. In the commercial field, as an indication of the *extraordinary* service level being conducted for their clients, a measure used by some service providers is the 'number of *single* items picked per day'. Again this was not specified as a particular indicator in the military, but observations by the author in its depots and in/during case M3, proved *many* single items were picked and dispatched - it may be that this is a norm in the military sector and therefore it is not measured/indicated as an *extraordinary* service.

+ Service criteria are used by businesses but they were reluctant to specify in full what were/are these criteria (this *may* be an indication of how Service is becoming a major competitive advantage factor?). However, it is possible to detect some of them from comments made in interviews and, other observations; they are factors like: availability; 'the number of single items picked' - mentioned above; customer complaints and; customer dissatisfaction levels. The customer satisfaction issue is prevalent in the army too; from case study M7 the logistics people wanted to hear: what the fighting arm wanted, and expected, of them; plus their dissatisfaction issues/matters. Whilst the military did not specify particular service criteria either, inferences can be made: availability; comparative performance/conformance data pertaining to the SPS priority levels/ranges; and (from M7) the author does know that when new contracts are set-up

Military and Expedition Performance Indicators:-

The front-line(s) are never short/without. (M1, M2, M3, M6, M7)
Availability - stock and equipment. (M2, M3, M4, M5, M6, M7)
Stock quantity completeness of allocated Army Divisions' full complement, and conversely the shortfall; expeditions too. (M4, E1)
Inventory accuracy and inventory condition (damage free and safe) - quality and number of live items. (M1, M2, M3, M4, M5, M6, M7)
Quantity of inventories/stocks on-hand. (M1, M2, M3, M6, M7)
Shelf-life consumables issued on a FIFO ('first-in, first-out' - oldest issued and/or used first) basis. (M2, M3, M6, M7, E1)
Packing security - damage protection and security. (M4, M5, M6)
Picking accuracy and on-time delivery and delivered to the correct address/map reference. (M1, M2, M3, M4, M5, M6, M7)
Losses - what, and how much was being stolen/taken/ambushed by the Boers. (M1)
Output based. Space/cube utilisation. Operational capabilities - based on what can be done and what cannot be done. (M5, M6, M7)
Matched resources (Establishment) for the level of operation(s)/readiness, i.e. under or over. (M2, M3, M6, M7, E1)
Coverage/sweep. (M1, M2, M3, M6, M7)
Supply handling capacity/rate and consumption/replenishment rates (tonne/day). (M1, M2, M3, M4, M5, M6, M7, E1)
Number of items ordered/handled/dispatched per time. (M4, M5)
The proportion of recommended frequency checks that are carried-out on equipment (1st. line support). (M2, M6, M7)
Safety. (M4, M5, M6, M7, E1). Training of staff (M2, M6, M7, E1)
Casualties - from combat, accidents and disease/sickness. (M1, M2, M3, M6, M7, E1)
Speed (i.e. time measures). (M1, M2, M3, M4, M5, M6, M7)
Cost (is an issue that is becoming prominent for the military). (M4, M5, M7, E1)
Teeth to tail ratio (fighting men to engineers/supply men). (M1, M2, M6)

Operations Evaluation (OPEVAL). (M2, M3, M6, M7)
National Audit Office (NAO) evaluations/surveys/audits. (M4, M5, M6, M7)
Advancement rate. (M1, M2, M3, M6, M7, E1)
Areas free of Boer attacks and areas where Boer activities could still be expected. (M1)
Number of horses needed versus the number obtained - shortfall. (M1)
Rate of construction of the blockhouses and linked fences. (M1)

Commercial/Business Performance Indicators:-

Product availability at store. (C1, C5, C9)
Order fulfilment rate and/or store stock replenishments. (C5, C6, C7, C9)
Inventory amount and its accuracy. (ALL)
% of 'live' items held (non-selling or returned were 'dead' items). (C2, C4)
End of month stock-targets at the store - observe and monitor/analyse the patterns. (C1)
Quality measures, secure/protective packing. (C4, C5, C6, C7, C8, C9)
Invoice accuracy. (C5, C8)
Accuracy of pick/delivery. (C1, C2, C3, C5, C6, C7, C8, C9)
Picked proportion ahead of time. (C2)
Number of single items picked per day. (C2, C4)
Service criteria e.g. No. of single items - others not specified. (C3, C5, C6)
Complaints and customer dissatisfaction. (C1, C2, C6, C8, C9)
On-time (or late) deliveries. (C1, C2, C3, C5, C6, C7)
Delivered to correct address/destination. (C8)
Losses/shrinkage/scrap and damages. (C2, C6, C7, C8)
Waste (% relating to store) 'past shelf-life' for foods and 'not-selling' for clothes/textiles/merchandise. (C1)
Productivity measures (e.g. cartons/hr, cartons IN and OUT, etc.). (C3, C4, C5, C7, C8, C9)
Consumption rates. (C8, C9)
Fleet/truck utilisation/idleness and space (cube) utilisation (vehicle and warehouse). (C1, C2, C3, C5, C7)
Accidents/injuries and safety. (C3, C8). Trained/versatile staff (ALL)
Time measures. (ALL)
Turnaround time - i.e. from receipt of goods to dispatch (IN - OUT time). (C2, C8)
Cost/accounting measures. (C4, C5, C6, C8, C9)
Process measures/control (e.g. temperatures, etc.). (C1, C3, C7)
Headcount (manning sheets) for wages/salaries and used as a denominator for most productivity measures. (C3)
Dating records of 'life-limited' computer components (traceability). (C9)

Distribution costs as a % of sales revenue. (C1, C5, C6, C8)
Number of late departures of lorries per shift. (C7)
Striving for logistics cost per pallet, per tray; and then ideally the: logistics cost per item. (C1)
Intake margin is known, but the logistics impact on the intake margin is not known. (C5)
Would like to measure 'lost sales opportunities'. (C6)

Table 11.9 Comparison of Performance Indicators

for outsourced military functions, one of the conditions emphasised is the Service Level Agreement(s) (SLA) within the arrangement. So, both use service criteria/factors.
+ On-time delivery and delivery to the correct destination are service measures used by both sectors.
+ Inventory/stock losses as a result of aspects external to the operation and those caused by the operation.
+ Distribution coverage/sweep: the area and range/reach that can be covered/serviced by a depot/node. The military set up this arrangement/infrastructure anew for every campaign/war. For businesses, this is planned and established in advance with the permanent replenishment network/infrastructure constructed for its long-term use.
+ Productivity and/or output measures like number of orders/items/checks handled per time/period and efficiency; utilisation measures of cubic space (in warehouses and vehicles); and utilisation of fleet/vehicles.
+ Supply/handling capacity rate(s); consumption rates; and replenishment rate(s).
+ Accidents, injuries, casualties - the safety aspects. Both sectors agree that safety is enhanced by good and proper training, which results in less accidents. For the military, an example is storing/locating phosphorous close to water access, etc.
+ Training of staff: on-the-job (OTJ) training is carried out by both sectors and staff versatility without demarcations is common to both.
+ Time measures and/or speed aspects - operationally in the guise of fast/quick processes and methods, as well as the obvious speed of transport. One of the most common measures used is 'turnaround time'. Both military and commerce assess their operations and performance by time, or time related, factors.
+ Obviously cost/accounting measures are used widely in businesses (and by Company Law(s) they are obligated to report a 'Balance Sheet' and 'Profit & Loss' accounts periodically). The military in general, and its logistics in particular, are beginning to use costs and accounting data for their quests to seek savings and introduce cost effective methods and processes. (However, the two sectors cannot be totally compared by *all* the accounting performance measures/indicators because - for instance - the assets owned by the MoD are *not* capitalised and it does not have a revenue as such, meaning that ratios like return on assets (RoA) etc., and the logistics contribution/effect to/on them (particularly with regard to the inventory/stock holding bearing), has no relevance in its case. Like for like logistics aspects/operations/processes/methods, however, can be compared and benchmarked between the two sectors.)
+ Process measures/controls like the temperature control (and proof record charts) of cold/chilled rooms where such products are stored. For the military, perhaps the simplest example is the process measures/controls associated with the provision and quality of drinkable water in the field.
+ The headcount which is available (and used) as a number (absolute count) is common to both sectors. For both sectors, a number of productivity ratios/measures/indicators use headcount in the denominator. The military require the logistics headcount value because of the possible impact it has on its capability/responsiveness and, there is also the 'teeth-

to-tail' ratio. For the business sector the headcount has a prime impact on logistics costs - because of wages/salaries - and therefore it adds to the overall costs which affects the profit margins and/or prices sought from customers.
+ The keeping of records connected with specific 'life-limited' parts and components (i.e. the tracking and traceability of them) is an aspect found common to both sectors. From the commercial case C9 the example obtained was associated with computer components. For the military case, from M5 the example obtained was associated with tank gun-barrels. Obviously, the principal use of this facility/procedure in both sectors is within aircraft components/parts management, but that was not covered in this research.

For the performance indicators, the main differences between military and business logistics are as follows:-
- The military conduct what it calls an 'OPEVAL' (Operations Evaluation) which is basically a *capability study* of what a logistics component/arm has set-up. Clearly, as the infrastructure for military logistics support has to be inaugurated every time a war/conflict commences, then an OPEVAL audit will point out/suggest improvements in order to help minimise or eliminate any inherent *weaknesses* and/or *riskiness* in the structure/system. The evaluation centres on what is considered to be *critical* in the particular job/mission in-hand. (It is possible to equate this with a logistics structure/system review/audit which is conducted periodically by some commercial enterprises.)
- A government body that conducts audits and 'value for money' (VFM) (and from April 2000 will also include 'best value' (BV)) operational surveys is the National Audit Office (NAO). The military are subjected to these surveys occasionally, usually instigated by a very senior person who believes that substantial savings can be obtained or, that something of an *irregular* nature is prevalent/suspected. After all, the MoD is answerable to parliament for its spending from the public purse. (Possibly, this could be paralleled with a cost reduction survey/audit that a commercial enterprise might undertake?)
- A measure/indicator used in the military and expeditionary circles is 'advancement rate'.
- From the Boer War (M1) case study some indicators/measures used were: areas considered free from Boer attacks and areas where Boer attacks could be expected; regular up-dates concerning the position surrounding the shortage(s) of horses and; the rate of construction of the planned restraining blockhouses and linked fences.
- A pertinent indicator used in the commercial world is the logistics (or distribution) costs as a proportion (%) of sales revenue. This is a reasonable generic ratio to benchmark against within an industrial sector.
- As most stores and factories allocate a 'delivery window' for their goods to be received, a performance indicator used by some commercial depots is the number of lorries per shift that *depart late*.
- Some businesses are striving to obtain a logistics cost per pallet, per case, per tray and ultimately, the logistics cost per item.
- Related to the above point, the 'intake margin' of goods is known by businesses, but the logistics impact on that intake margin is not known. Reaching the stage of the point

immediately above will provide data to rectify this anomaly.
- One elusive performance index that some businesses would like to measure is the 'lost sales opportunities'.

11.5.4 Comparison Of Dimensions

The comparison of the military and commercial logistics dimensions is shown in Table 11.10 from which it will be noticed that there is hardly any difference at all. The only slight questionable dimension is the stock keeping unit (SKU) which is a commercial dimension and has a unique product identity code of its own. The military did not possess such a term, but it does have 'cases' which is a form of SKU. For instance, from case study M2 and M3, the composite ('compo') food came in cases which contained rations - individually packed - for ten people; this is basically an SKU. Also, ammunition came in cases - another SKU - although the preference was to transport them by the pallet load (consisting of many cases) with six to eight pallets per DROPS flat-rack. After the preceding argument, this was considered to be equivalent.

The military and expedition side of Table 11.10, therefore, has all the commercial dimensions, plus two unique ones, which are: the scope and area of the continental mass upon which the military might be fighting (and the explorers might be scrambling) over and across which supplies would have to be carried/transported and then replenished as needed; and the personal fitness and general good health of the soldiers/participants.

11.5.5 Consolidated Analysis And Findings

From the mass of information/data gathered in the case studies for this thesis (i.e. the primary research) the above analysis was the result of a methodical data reduction, deconstruction and segregation process. With a greater understanding of the underlying, or sub-lamina mechanisms, it is possible to reassemble the data in a revised format and hence picture the whole again, but, from a different perspective and in an holistic manner. Basically, by way of the learning gained from both the military and commercial logistics research, through model formulation and data restructuring - thus, to providing real *understanding*. This is what follows now.

11.5.5.1 Fixed And Mobile 'Nodes'

The existence of mobile nodes in the military and the fact that commerce tends to have only fixed nodes, stimulated an inquiring interest as to the meaning and ramifications involved. From the investigation into the evolution of military logistics, it was fascinating to observe that the early warriors, when on the move, mainly carried their own accoutrements and 'lived off the land', because mass transport of provisions was very difficult, or not yet available. Of those times, Thompson (1991:11) wrote: 'to live, keep moving'. Also, because of the difficulties encountered with a moving army, some

Military and Expedition Dimensions:-

Scale and intensity of the operation/war/conflict/hostility.
Costs (£).
Value of inventory (£).
Amount/quantity of inventory (It, number off, volume, tonne (Mg)).
Number of items (It).
Age of inventory.
Cases (number off).
Output rate and consumption/usage rate (amount/time).
Transport/fleet size and make-up/profile (including horses).
Weight (kg and/or tonne (Mg)).
Distance/reach/range/sweep/proximity (km and km^2).
Destination address/map reference.
Speed (km/hr).
Headcount (number of soldiers/expeditioners).
Capacity handled in time periods (tonne/day (or Mg/day)).
Time or duration (e.g. lead time or sustainable duration) (hours or days).
Specific stated point in time (or delivery window).
Space: Area (m^2); and Volume/Cube (m^3).

Scope and area of continental mass.
Personal fitness/health level of the participants.

Commercial/Business Dimensions:-

Scale and intensity of the total operation and hence a designed system.
Costs (£) obviously via its constituent/component parts, viz: labour; fuel-energy; damages; wastes; space; and overheads.
Inventory/stock value (£).
Amount/quantity of inventory (It, number off, volume, tonne (Mg)).
Number of items (It).
Inventory age.
Stock keeping units (SKUs).
Cases (number off).
Output rate and consumption/usage rate (amount/time).
Transport/fleet size and make-up/profile.
Weight (kg or tonne (Mg)).
Distance/reach/range/sweep/proximity (km and km^2).
Destination address.
Speed (km/hr).
Headcount (number of people).
Capacity handled in time periods (cases/day, pallets/day (or Mg/day)).
Time or duration (e.g. lead-time) (hours or days).
Specific stated point in time (or delivery window).
Space: Area (m^2); and Volume/Cube (m^3).

Table 11.10 Comparison of Dimensions

societies like the Assyrians choose/preferred defensive tactics from a fixed node by building castles (or stone buildings like Martello Towers) and storing vast stocks of food and provisions to sustain themselves. Logistics support for a fixed defensive strategy was/is much easier than logistics support for a mobile offensive strategy. This fact was probably one of the reasons why static trench warfare seemed so prevalent during the Boer War and WW1.

A matrix model, Figure 11.2, was devised to depict the variables of mobility versus fighting style/type that showed the possible combinations.

	Defensive Strategy	Offensive Strategy
Mobile Node	Retreating Army and/or Pursued Covert Operations Personnel	Advancing Army
Static Node	Besieged Town/City	Besieging Army and an ICBM Base

Figure 11.2 Military Fighting Style Versus Node Mobility Matrix

From Figure 11.2, it can be seen that an advancing army is a mobile node employing an offensive strategy; this poses difficulties for logistics support. This combination was a popular one with Alexander the Great, so it is not surprising that he developed novel logistic ideas - for his day - to sustain his successful advances. Examples where this mobile offensive combination was disastrous are: the British Army in America during the American War of Independence 1775-1783 - the fighting/advancing British Army was at the end of a 3 000 mile transatlantic supply line harried not merely by the enemy but also by the wind or lack of it, as well as being faced with the problem of preserving and stockpiling food in the era before the tin can (Bowler, 1975:7); and the British 24th Regiment's defeat and annihilation by the Zulus at Isandlwana (or Isandula) in January 1879. Examples of defensive strategies via a mobile node are retreating armies (in fact William the Conqueror employed this strategy with his 'feigned retreat' to draw down Harold's army from Senlac Hill, near Hastings, in 1066). Another example of such a combination is covert operations' personnel who are being pursued by their enemy. Again, this admixture presents a difficult logistics enigma to maintain support/sustainment. For these two mobile node patterns, it is hard to find any commercial similarities.

A besieged town/city is an example of a fixed/static node employing a defensive strategy. The Zulu War battle at Rorke's Drift-Shiyane, and the sieges of Ladysmith, Kimberley and Mafeking during the Boer War, are classic examples of this combination, where the emphasis is on sufficient stockpiled ammunition, food and provisions to sustain the duration of the siege, until it is either won, overcome or relieved (Foxton (1994:102-106) referred to such situations by the umbrella term of 'Isolated Operations' which meant central control of accurately listed assets/stocks/inventory was essential). Characteristics here are: to *stretch* the resources (economy of use); to seek duality (and more) of purpose for which items and aspects can be used/employed; and to be creative in seeking/finding substitutions and alternatives. Defensive walls (e.g. Hadrian's and the Great Wall of China) employed this static defensive strategy. The final combination, consisting of a static node engaged in an offensive strategy, can be exemplified by: a besieging army (excluding any interdiction); an Inter-Continental Ballistic Missile (ICBM) Base; perhaps an off-shore moored aircraft carrier/battleship firing missiles at an enemy, or targets who/which is/are a very long distance away; and an 'out-of-theatre' marshalling area/yard - like Al Jubayl was for the Allied Forces during the Gulf War of 1991.

It is these last two cases with the static nodes that bear a strong relation to commercial logistics. The static node and defensive strategy can be likened to a factory/service centre where the focus is solely on managing *internal logistics* - very much akin to the level (1) scenario of Figure 5.1 (page 163), explained on page 161. (In fact, the author knows of manufacturing companies that are planning exactly this stockpiling strategy type, in order to *insure against* any millennium computer non-compatibility (Y2k) problems/issues impacting their operations.) The case of a fixed node and being offensive is probably the best fit comparison of a commercial logistics system. Here, the supply system(s) feed into the node/base to sustain it and to replenish the consumed/expended materials. The similarity between the military and commercial logistics ends when the unit/troop/company/brigade (i.e. the customer/consumer) goes *mobile*.

11.5.5.2 Contactivity And Connectivity

One of the emerging factors that stands out is that the military have very good radio communications and that it is backed-up by a very strong internal relationship between the soldiers. Much information transfer takes place between soldiers by talking (via radio, telephone and, face to face) with verbal clarifications and explanations offered about matters, options and solutions. This is borne out in all the case studies conducted but particularly in M3, from the fact that all of the soldiers knew each other and were aware of their purpose. Commitment was demonstrated by them when, for instance, there was a shift change-over in personnel, when many of the incoming shift arrived early to comprehend the situation as fully as possible prior to actually taking over and commencing the shift. Some of the out-going shift members stayed around to offer their knowledge of the current circumstances and be of help to the in-coming shift until there

was a contented feeling that they could not be of further assistance. This phenomenon was consistent throughout the chain/network. To sum it up, in the military, for communications and information transmission, there was a very high degree of *contactivity* between the soldiers conducting the logistics support.

The case studies conducted in the business sector yielded that a very strong component of commercial logistics is computerisation and electronic data/information transmission. Very often, the data capture method/technique is electronic too, with automatic information transmission within a *real-time* system offering immediate computer screen visibility of the current status/position throughout the chain/network. Furthermore, many of the decisions and suggested/recommended actions necessary for replenishment are made/taken automatically by the computer system which has pre-programmed software possessing the appropriate rules (O-LAP), conditions and logic to apply to the received data/information of the chain/network operation. It can be stated that within commercial logistics there is a very high degree of *connectivity* between and throughout the nodes (suppliers/depots/stores).

For a pictorial representation of the above findings, a spectrum chart was drawn-up to illustrate this contactivity to connectivity range. Figure 11.3 shows the comparison spectrum and relativity from the military high contactivity to the commercial high connectivity.

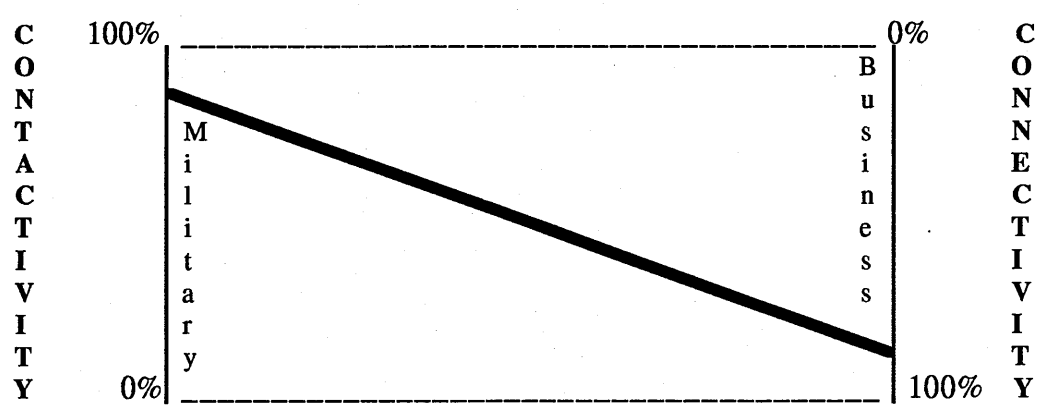


Figure 11.3 Military Contactivity and Business Connectivity Comparative Logistics Spectrum

11.5.5.3 Holistic Logistics Model

From the above analysis, outcomes that are similar for both military and commercial logistics are:-

• The behaviour of the logistics structure in both sectors is governed by the power which is held/possessed, generally, at the penultimate node of the user/customer end of the

chain/network. (The ultimate node - end of the chain/network - is the buying customer in a retailer for the commercial case and for the military case there are two end nodes: the front-line fighting arm which requires food, clothing, other human sustainment aspects, equipment, spare parts and the ammunition to fire at the enemy; and the enemy who has the ammunition fired upon him/her.) For the military, the power is with the front-line commander (in M2, M3, M6 and M7). For commerce the power lies predominantly with the High Street retail multiples (in C1, C2, C3, C4, C5, C6 and C7). These power-holders stimulate and activate the supply chain/network in order to achieve their aims and objectives.

• Both logistics are information led. The logistics systems respond to the information that is fed backwards up the chain/network. (Two-way information flow does exist; usually this occurs when a supply/delivery cannot be met, and advanced warning/notice is given/transmitted/communicated foreward down the chain/network. Other occasions when this is used are for general status and/or progress reports (all case studies).)

• Communication media used by both sectors are the same, consisting of person to person, mail, fax, telephone, radio, satellite and EDI. However, there is a difference in the degree of use of certain communication media. For instance, the military logistics communications are via radio, scrambled (i.e. secured) telephone and fax (i.e. Tac Data Transmission (TDT)), and much face to face dialogue (in M2, M3 and M6). Business sector logistics communications are becoming heavily dominated by EDI (all commercial cases). (In general, apart from communications, there appears to be a converging of technologies used in the logistics of the two sectors.)

• The above two items indicate that both logistics are demand driven, that is they operate a 'pull' system.

• Both logistics consider 'lead-time' an important variable. Sometimes this is a 'fixed period' like the 24 hour replenishment cycle used in the retail sector (in C1, C5 and C9) and, in other cases it is the fastest (i.e. shortest) time possible such as the evacuation of a battlefield injured soldier to a safe medical attention area (M3 and M7). Changing processes to do things faster can be taken as a time advantage using the same resources or as a cost reduction by reducing the resources and retaining the original lead-time.

• Relationships within and between parties (and people) in the logistics chain/network are recognised as a synergistic and catalytic factor to augmenting logistics performance (all case studies).

• Both sectors are very interested in reducing logistics costs - the commercial side has had a serious cost reduction aim for the past forty years. The military are now seriously poised to look at logistics cost reduction but without damaging or reducing its capability, in fact with a view to enhancing its capability as a result, if possible (all case studies).

• In both sectors, the structures and infrastructures are designed so that the correct response and customer service levels can be attained/met. Businesses plan and design their logistics structures and infrastructures for a smooth, continuous and reasonably long-term operation. These are modified and adjusted to incorporate new demands, service expectations from customers and/or new technologies that will improve and

enhance the total logistics system (usually stimulated by a change management (like a Business Process Re-engineering (BPR) programme) and/or the introduction of an Enterprise Resource Planning (ERP) (like SAP, Baan, PeopleSoft or Oracle) IT/IS system). The military has to set-up/establish a novel logistics structure and infrastructure for every new circumstance, normally using its Logistics Doctrine(s) and past experiences (if remembered) as guidelines, knowing that these structures will have to change and be altered according to the battle/war outcomes (i.e. *new needs*) and general progress. Hence the military need, or require to be able to add (or subtract) a *logistics scion* as necessary and/or possess the means for a *regenerative* logistics capability to cope with the forced changes, or indeed, should more than one battle (two or more 'front-lines' or campaigns/wars/conflicts) be fought simultaneously (from M1, M2, M3, M6 and M7).

From all the above variables, an emergent (possibly generic) model of logistics in the two sectors has been developed, see Figure 11.4. The model comprises a demand profile depicted by the upper half which emanates from the power holding customer end of a supply chain/network. The task, or role, of logistics is to develop a structure and infrastructure that will respond with the right/appropriate service levels, thus matching or meeting, the expectations of the demander/customer but, with efficiency and effectiveness at an acceptable, ideally an optimum, cost - realising that a permanent aim for business is continuous cost reduction, and the military are now also seeking cost reductions/savings from and within its logistics. This is represented by the lower half of the model - the response structure or profile - from the supply end. Accurate information, coupled with the communication medium that transmits it, contributes largely to efficiency (realising that in the military, because of its doctrines and inventory dispersal philosophies/policies, a debit is taken in operational efficiency), whereas lead-time reduction and relationships leverage effectiveness.

Two of the case studies from the commercial sector allowed a superimposition to be incorporated onto the model. This addition is brought about by the fact that the two retailers in question (i.e. C1 and C7's customer), operate their own logistics for part of their total operations, as well as employing an outsourced logistics service provider to furnish the logistics for another part of their operations. This enables the two retailers to retain an understanding of logistics in-house by running a logistics operation themselves and at the same time compare and benchmark themselves wholeheartedly with their outsourcer. This constant comparison and benchmarking enables any ideas, improvements and enhancements in the logistics response structure/profile found in one party's system to be encompassed by the other party of the common operations. (This is a kind of "two heads are better than one" approach to achieving problem resolutions and/or performance ameliorations. An extra benefit for the two retailers is the knowledge gained by virtue of the outsourcers' experience adduced from their other customers for whom they run logistics operations. Also, should any of the retailers wish to absorb and

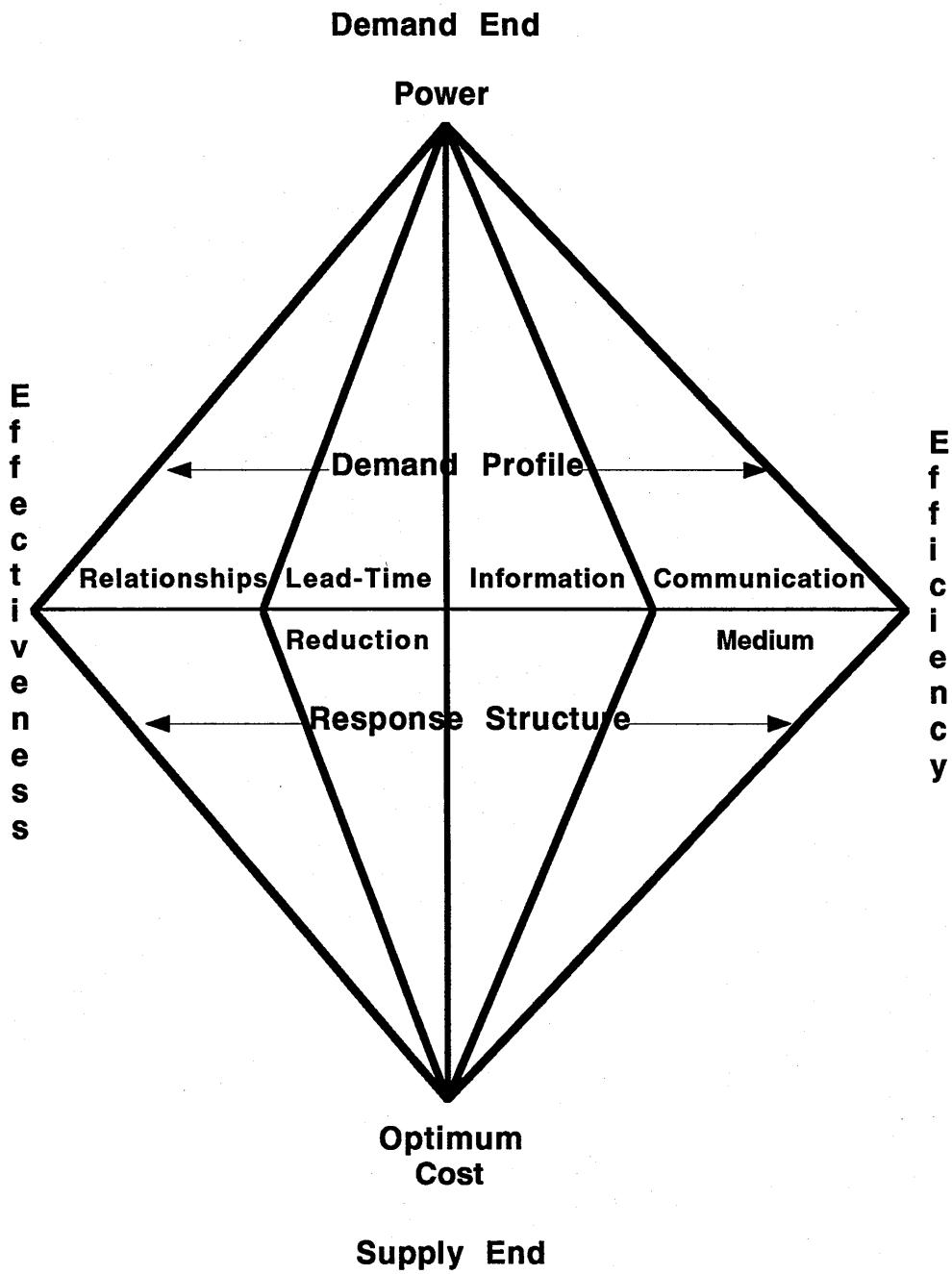


Figure 11.4 A Possible Generic Logistics Model

resume all of their logistics operations in-house, then it will not be a complete *'starting from scratch'* affair - sufficient logistics operations expertise will have been kept, and be available, within the organisation.) The extended model delineating this structure/profile benchmarking and process comparisons of the two logistics structures and response profiles is shown in Figure 11.5.

A further extension of this emergent model can be made. The case study retailer C1 uses two different logistics service/third party providers. This offers the retailer *another* set of benchmarking data, and experience source ("two *or more* heads are better than one"). Figure 11.6 shows the benchmarking elements with the *two* third party or outsourced participants superimposed onto the original model. By using itself as the datum, the data and benchmarking from the two outsourced response profiles/systems enables the C1 retailer to capitalise on the obtained benchmarking knowledge and therefore gain/possess a competitive advantage with its logistics system(s).

11.6 The Matrix Of Logistics Types

The next stage of the analysis is the attempt to validate, or otherwise, the matrix of logistics *types* formulated and shown in Figure 8.1 (page 226) by locating suitable eligible examples into the matrix hypothesis.

11.6.1 Examples Of Military Logistics Types In The Matrix

All interviewed military personnel (over 40 in total) and military associated people to whom the hypothetical 'logistics type' matrix was presented and explained, firstly recognised the content of the construct and generally accepted its plausibility. Many made the comment that the first quadrant - i.e. War - actually encompassed all the other types of logistics contained by the other three quadrants; an M2 interviewee said: *"In a position of war we would be providing, and in fact we do provide, all of those types of logistics."* The attempts at placing some military examples into the 'logistics type' matrix hypothesis are shown in Figure 11.7. With regard to the first quadrant - War - which consists of a protracted campaign and continuity of demand met by multiple sources and links, some examples are as follows. After the Romans' initial conquests and attached colonies had reached a reasonable size, their quest for expansion, and to become an Empire, was predicated upon further conquests and the annexing of neighbouring domains/states and territories in all directions; a kind of ever increasing circumscription of realms around Rome. With such a large Empire possessing many 'bases' as back-ups, the resources of the whole Empire could be called upon when advancing to conquer another country. One such example was the Roman-Jewish War (66-74 AD), where the distribution of provisions followed the first quadrant type. Supplies and provisions were collected in operational bases and moved to the front lines via a network of depots and linked supply lines. Tactical bases supported the Roman Army at various locations in the field, whereas

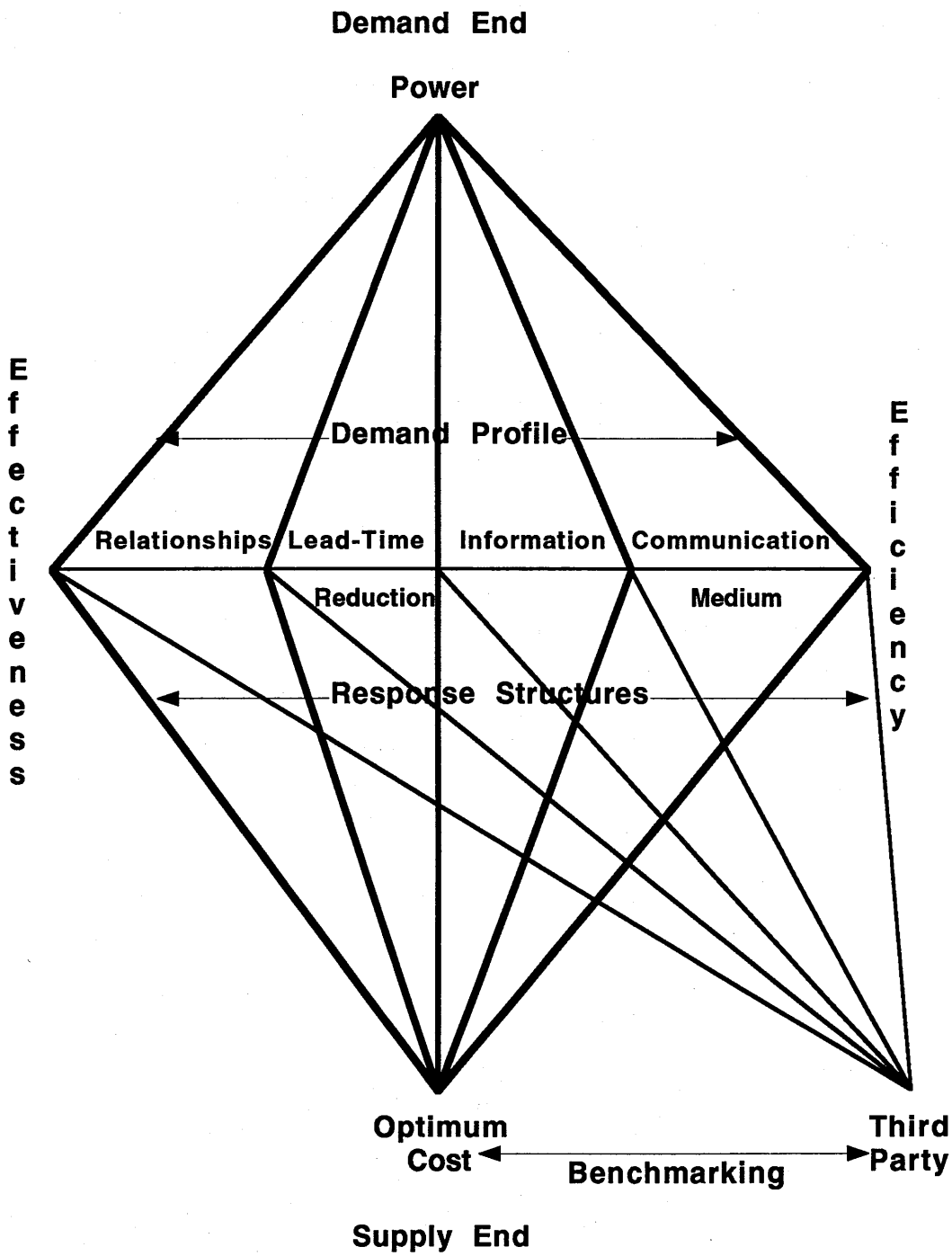


Figure 11.5 Owner/Operator Logistics Response Structure/Profile Compared and Benchmarked With a Third Party Logistics Response Structure/Profile

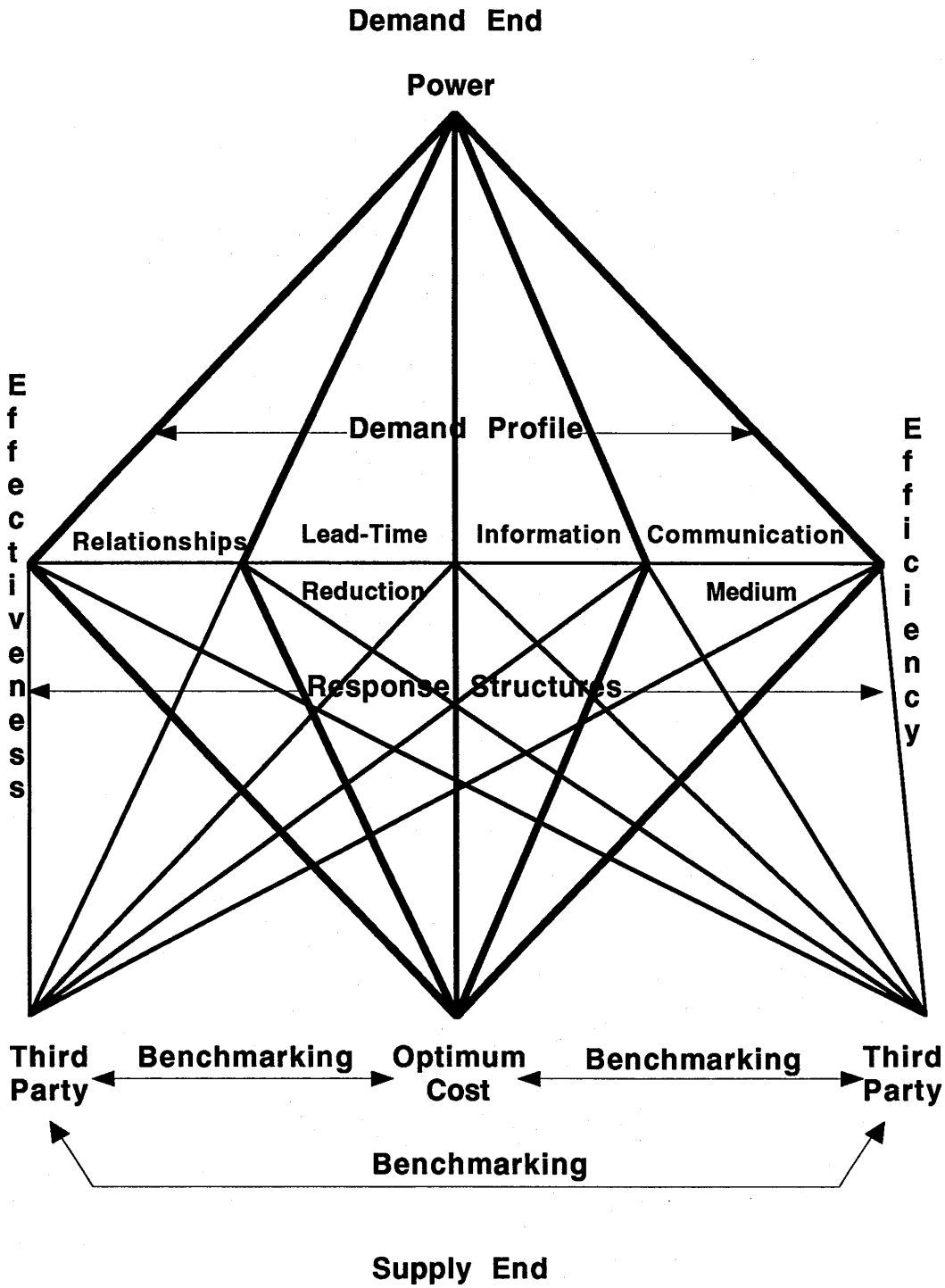


Figure 11.6 Benchmarking of Three Response Structures as Used by C1: Using Itself as the Datum

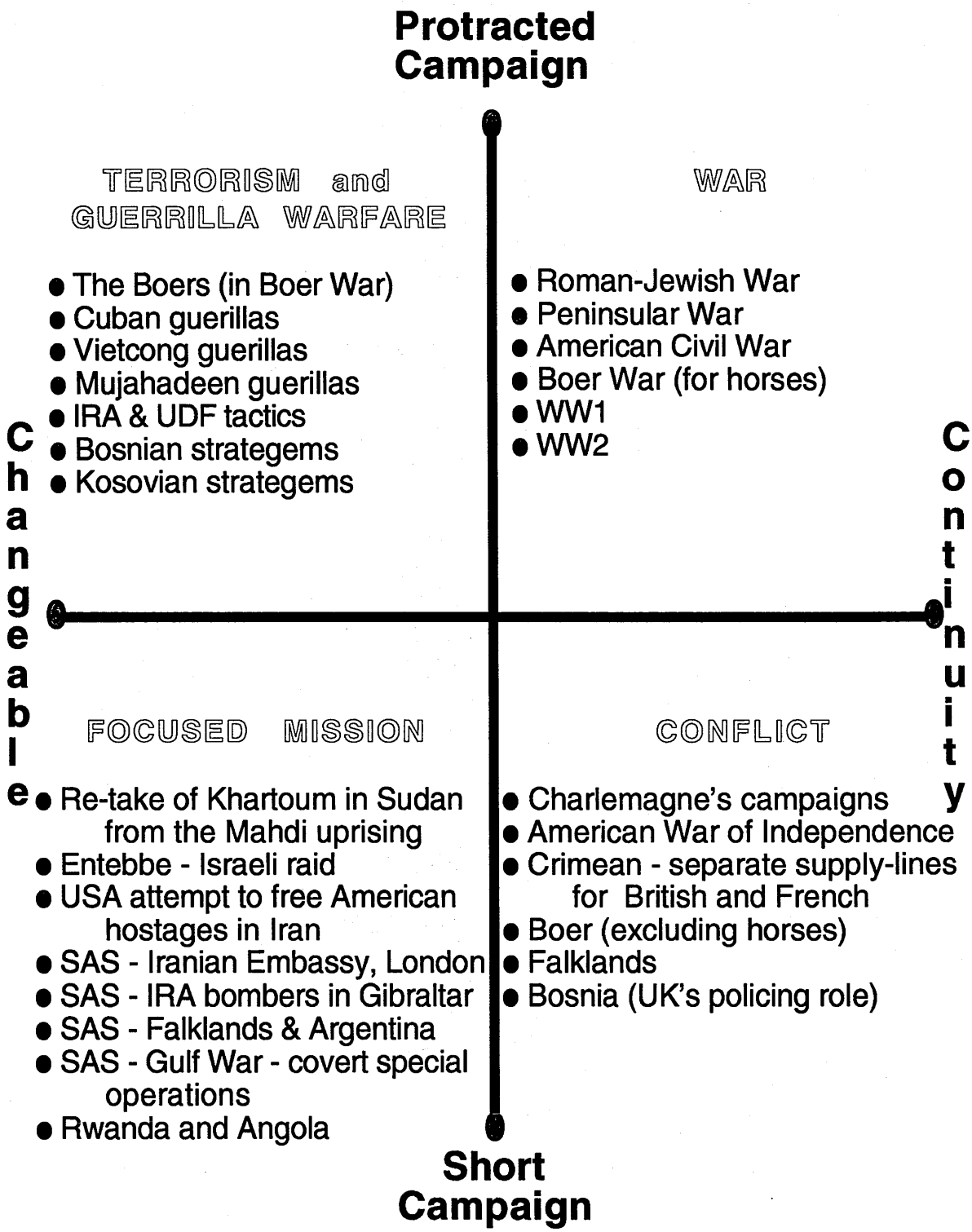


Figure 11.7 'Logistics Types' Matrix (Hypothesis) Military Fit

campaign logistics were administered on an *ad hoc* basis and there was probably a permanent military accounting office in existence which suggests an organised logistics network structure.

The Peninsular War (1808-1814) is another fit into this first quadrant. The British Army had some supplies from England and they purchased other supplies from the Spaniards and Portuguese whilst acquiring (by stealing and requisitioning) from the French - their enemy. Both sides of the American Civil War (1861-1865) (but particularly the South who had to obtain equipment and gunpowder, etc. from abroad and by interdiction) had to set-up multiple supply sources and links. To sustain the Boer War (1899-1902) with the required demand, the British had to obtain horses on a world-wide source basis. The need for such a quantity could not have been met from/by a single source or nation and therefore this aspect of the Boer War belongs in the first quadrant. Both WW1 (1914-1918) and WW2 (1939-1945) belong in the first quadrant due to their sheer magnitude, the land masses/scales that they covered and the number of nations involved.

The second quadrant - Conflict - consists of a short campaign and continuity of demand met by a linear supply chain. Military examples that this quadrant embraces are as follows. Charlemagne's campaigns were supported/supplied by supply trains from France: when he defeated the Saxons, which took many conflicts during the period of 772-804; when he defeated the Lombards 773-774; and when he fought the Arabs in Spain. By employing this logistics linear chain system he was able to take control of most of Christian West Europe. When the British fought the American War of Independence (1775-1783) (which was the central portion of the American Revolution that spanned 1765-1788), all supplies had to be brought from Britain. No dependable supply of provisions was available to the British from, or on, the American continent for that phase. For the Crimean War (1854-1856), both the British and the French contingent supported their own forces alone and therefore both had a single umbilical cord supply line from the mother country feeding her own troops. To fight the Boers (1899-1902), the British forces supplied all their equipment and provisions from England (excluding horses). Similarly, for the Falklands conflict of April - June 1982, the British furnished everything needed from a single supply link out of the UK.

The third quadrant - Focused Mission - consists of: very detailed planning; carry, or take, everything with you; strategically placed magazines; and possibly live-off the land scenarios. Some of the military examples that are encompassed by this logistics type are as follows:-

• Khartoum, Sudan - the scene of the British defeat against the Mahdi uprising, in which General Gordon was killed in 1885; the city was regained by Lord Kitchener with a combined British-Egyptian *Focused Mission* offensive in 1898.

• Entebbe airport, Uganda, the scene in July 1976 of a dramatic rescue mission by Israeli

forces of Israeli passengers whose plane had been hijacked by a group of Palestinian terrorists.

• The attempt in April 1980, (under James (Jimmy) Earl Carter's presidentship) to free/rescue US hostages held in Iran. The US military carried out a desert helicopter raid for the rescue but the mission was a failure and ended in disaster when a C-130 air tanker and a RH-33D helicopter collided.

• The successful military ending of the Iranian Embassy siege in London which was executed by the SAS in May 1980.

• The killing, by the SAS in March 1988, of three PIRA bombers who were suspected of attempting to create a bombing havoc in Gibraltar.

• The many *covert* missions carried out by the SAS throughout both the Falklands War (both on the Falklands/South Georgia and in Argentina) and the Gulf War.

• The works currently being conducted by: 5 Brigade Logistics Regiment in Rwanda and the 9 Support Regiment in Angola. (These examples came from the participants in M7.)

Normally, the public do not hear of the many expeditions conducted by the military (from case study M4, about 600 per year carried out by the Army alone, usually as, or in the form of adventure training or cartographic/surveying data collection). However, when something goes wrong on these expeditions, news is widely reported, viz: the Low's Gully expedition in Borneo of March-April 1994 where the members of the expedition team had disagreements so, when difficulties arose, they split-up and went separate ways; and the Mount McKinley expedition in Alaska of June 1998, where an accident occurred involving a team member who fell down a ravine. These clearly fit into the third quadrant.

The fourth quadrant - Terrorism and Guerrilla Warfare - consists of detailed planning to supply specialist needs and a fast response. The following are just a handful of the logistics support/supply examples that qualify for this quadrant:-

• The tactics used by the Boers during the Boer War of 1899-1902.

• In Cuba, the guerrilla tactics used by Fidel Ruz Castro against General Fulgencio y Zaldivar Batista, which although unsuccesful in 1953, were succesful during 1958-1959.

• In Vietnam the guerilla forces (the Vietcong) that fiercely fought the South Vietnamese government (and the Americans) in the Vietnam War of 1965-1972.

• The Mujahadeen ('holy warriors') - Muslim guerrillas who resisted the Soviet occupation of Afghanistan after the invasion of December 1979. Based in Iran and Pakistan, they formed various armed bands united by their common aim of defeating the invaders, and the conflict was proclaimed a *jihad* ('holy war'). As the Russians could not counter the 'hit-and-run' tactics used against them (the guerrillas were helped by the rocky and mountainous geographical terrain), they withdrew from Afghanistan in 1989 (and the Mujahadeen subsequently experienced much internal dissent over their role in the country's future).

• The methods employed by PIRA and the UDF (Ulster Defence Force), as well as many

other splinter groups, in Northern Ireland for many decades.
• The stratagems used by the Bosnian and, later, the Kosovian nationalists, fit into this quadrant too.

11.6.2 Examples Of Commercial/Business Logistics Types In The Matrix

All but one of the interviewed business/commercial logistics people and associated personnel (over 45 in total) to whom the hypothetical logistics type matrix was presented and explained, recognised the content of the construct, and again general acceptance of its plausibility was confirmed. (The one person who did not give affirmation claimed that it was a military model and would not entertain the model as he did not know anything about military logistics.) The attempts at placing commercial examples into the 'logistics type' matrix hypothesis are shown in Figure 11.8. The first quadrant - Supply Network Management - examples are as follows. From the case studies, it appears that this is everyday life for most: Supermarkets (C1 and C7's customer); High Street Stores (C1, C6, C9 and C5) and; Factories/Service Centres (C8 and C9).

In the second quadrant - Supply Chain Management or Pipeline Logistics - the following examples were found. Some of the stores of C1 and C7's customer have local suppliers of fresh produce like bread which is baked locally and delivered direct to the stores and as such is not handled via the composite depot system. For Christmas and Easter - and other promotions - some of the C1, C5, C6 and C7 stores, because of regional taste (and/or fashion) variations, have special offers which are handled by a single supply chain arrangement. Also handled by this sort of logistics are the products that have a short-life seasonal period like Mothers'/Fathers' Days, National Holidays and other occasions such as Royal Weddings/Jubilees, etc. Another example here is regional needs for medicines to combat a local medical epidemic.

In the third quadrant - Expedition Logistics or Project Logistics - many of the commercial case studies gave similar examples, as follows. The first is taking displays, stands and samples, plus the associated back-ups, to Exhibitions; sometimes there is a string of Exhibitions running consecutively in different regions. The developments, trials, and debugging of new logistics systems (and IT/IS systems), procedures and processes are *proved* at a local level (i.e. developing processes that are 'transplantable') before launching the full 'pro-active' project/system network-wide, that is transferring it to quadrant one or two (this is a risk reduction strategy that C1 employs). The supplies/deliveries to *new* stores are normally handled (and monitored) as a project until there is no doubt that their success is in question. A noteworthy example came from C3 with the example of his client - C1 - who was conducting some corporate hospitality at a prestigious golfing tournament in Wales. C3 was given the strict instruction to keep the marquee stocked with specific items for the guests' convenience and never run short - availability was the most important aspect in this case - irrespective of the costs. From

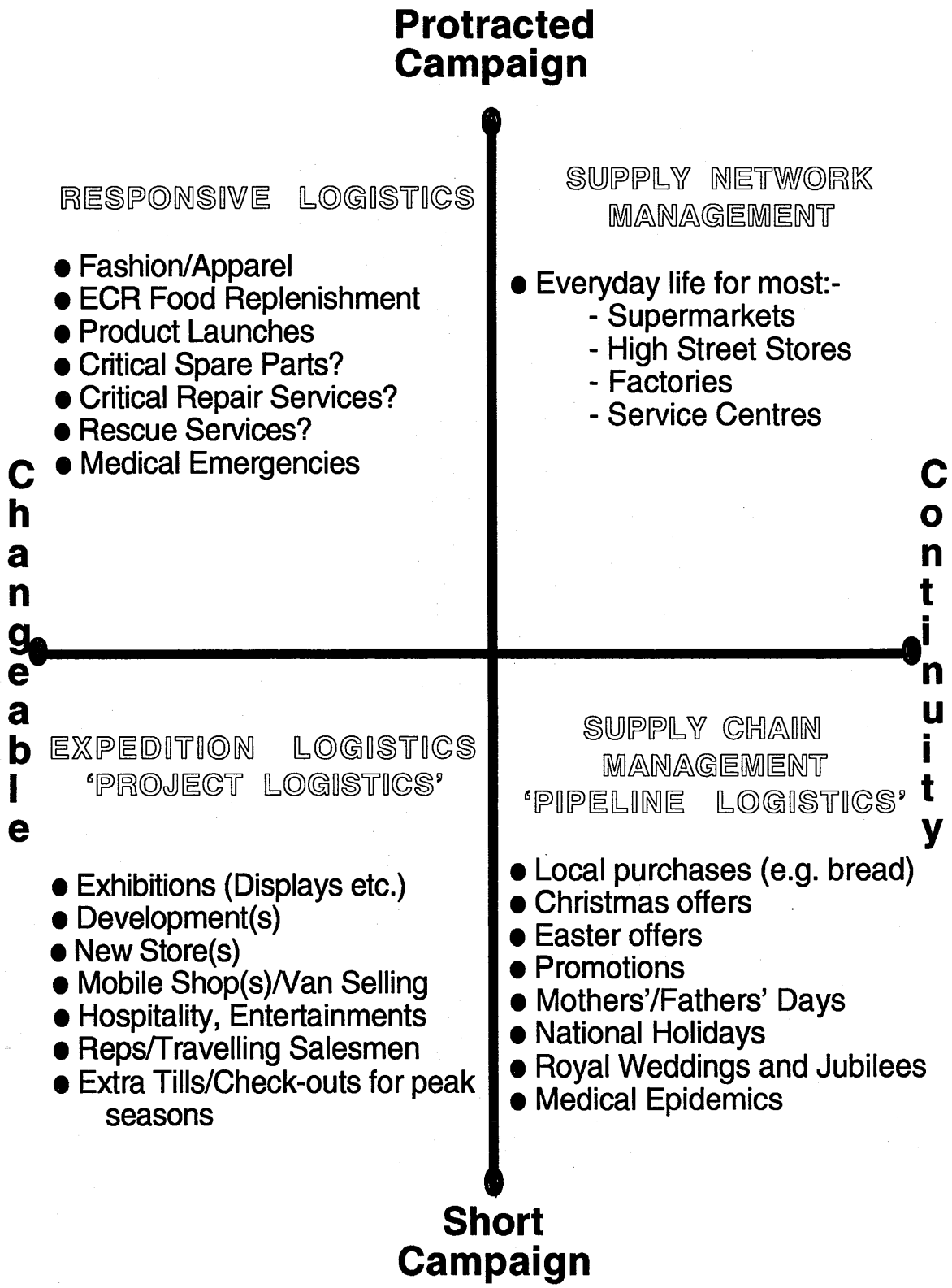


Figure 11.8 'Logistics Type' Matrix (Hypothesis) Commercial Fit

C1, the supply of extra/additional service/check-out tills that are pulledfrom a central store-room and set-up in the shops for/during peak sale seasons. These are then removed from the shops and returned to the store-room after the peaks. Obviously, mobile shops and van selling are other examples that fit into this quadrant.

In quadrant four - Responsive Logistics - examples for this section were scant. C1, C5 and C6 were the apparel industry samples within the commercial case studies set used for this research and all three were aware of the Quick Response Logistics (QRL) theory. However, the five stage QRL model as it is described in chapter 6, is only fully employed/operated by C1; for the other two, only parts of the QRL system in each case are operated. The full potential of the QRL system is not being fully realised yet for C5 and C6. C1 (with its third party logistics service provider C3) and C7 were the food industry samples within the commercial case studies set, and they both fully used the QRL system and infrastructure up to and including Stage 3 - i.e. replenishment partnerships and which basically constitutes Efficient Consumer Response (ECR). Some monitoring takes place by C1, and the data collected was analysed and used, particularly for *new food* products/product launches. An interesting, and sad, finding from this research is that outside of the apparel industry, the proper Quick Response Model is unknown.

In essence, it was found that QRL is all about ***active communication*** via the following:-

• Know exactly what was sold:	with	- Point of Sale (PoS) data using the Unique Product Code (UPC)
• Know what was needed/ordered:	with	- Purchase Order (PO)
• Know what was sent:	with	- Advance Shipping Notice (ASN) and Unique Container Code (UCC)
• Know what was received:	with	- Delivery Confirmation (DC)
• Know what was returned and why:	with	- Reject Goods Note (RGN)

Predominantly, all the above are achieved electronically - both data capture and data transmission.

Other than those few examples above that fit into the fourth quadrant, the author can only speculate what else might fit. Possible additional examples could be: critical spare parts; critical repair services; rescue services; and medical emergencies.

Following the above analysis, the conclusions follow now in the final chapter.

12. CONCLUSIONS

"Imagination is more important than knowledge."
"If I can't picture it, I can't understand it!"
Albert Einstein (1879-1955)

12.1 Preamble

As it was recognised that one's position in the logistics structure could prejudice or cloud the view taken, the case studies in both sectors were such (some chosen so and some worked-out fortuitously) that they spread across and represented the whole supply chain/network (or value stream), so that views and opinions were taken from many relative positions. Hence an overview could be obtained/formed from a *particular position* as well as from *the totality*. During the analysis phase, all efforts were made to stay close to the actual data collected and the assertions made were backed-up by evidence like quotes, documentation and/or observations. As some case studies were offered conditionally, compliance with, and adherence to those conditions have been met. However, it must be borne in mind that this state limits the scope of a research of this nature. An example was where IT/IS systems access was barred, because these systems were considered commercially superior and their owner wanted to stretch the longevity of such a position in order to maintain a competitive advantage for longer. This is, and classified as, a KNOWN unknown, but barring access also prevents the UNKNOWN unknowns from being discovered. Therefore, known unknowns exist and they can be speculated upon, but the unknown unknowns have *not* been found/discovered which contributes to the torpidity of advancements in the logistics area/field.

As the military assemble logistics systems/structures and infrastructures according to the demands and requirements of wars/campaigns and their policing activities, it is *not* surprising that the business/commercial community knows little about military logistics. When the war/campaign or activity is over, the (temporary) military logistics structure/system is dismantled (i.e. it is closed-down), so very rarely, if at all, does a business logistician get to see, inspect and learn from military logistics. Some military logistics literature (of a general nature) is beginning to emerge for the perusal by the business logistician/practitioner. Perhaps, one possible way for businesses to appreciate and learn more about military logistics, is for them to have access to the Post Exercise Reports (PXRs) (from case studies M2, M3 and M7) that the military write and compile to record their findings, efficiencies and deficiencies, and general logistics effectiveness after an activity/exercise. This would help the transfer of applicable logistics aspects from military to business. However, it is evident from this research that the technologies used by logistics in both sectors (like transport modes, material handling, packaging, communications, computers, etc.) have converged, and are still converging. Notably, throughout history, the pioneering of many logistics advancements were sponsored, tested and proved by the military. Usually, these days, in order to expand its market, any

enterprise that has sold a successful logistics product/aspect/aid in one sector, tries to convey those same features and benefits to the other sector.

12.2 Contributions To Knowledge

Excluding the novel treatise on the variables of logistics in Chapter 7, six other distinct contributions to knowledge have been made by this thesis and they follow now.

12.2.1 Contribution One

From the literature searches/survey it has been discovered that Borsodi (1927) and McNair (1950) were the *real/true* reporters of logistics cost reduction potential, *not* Drucker (1962), who seems to be given most of the credit and often receives the accolade. Whilst it is understandable that comparatively few people know about Borsodi (1927) because of the period since (i.e. 70 years ago) and the rarity, in terms of availability of and, accessibility to, his book, the same argument cannot be construed for McNair (1950). A possible explanation in McNair's case is the timing. From the point of view that he made his remarks soon after WW2, his contribution was overshadowed by the attention which was still being paid to repairing war damage and building, developing, constructing and stimulating the economy in general. By 1962, when Drucker made his comments, the business world was seeking opportunity areas to reduce costs - and physical distribution management (PDM) was a relatively *untouched* area.

12.2.2 Contribution Two

From the historical evolution (i.e. secondary research) work, it has been discovered that both military and commercial logistics followed the same integration paths, from 'internal' through 'channel' to 'spatial/global', but at different times and in different time periods. The military, probably driven by their peculiar circumstance(s), pursued the integrated logistics concept first - centuries before commerce/business. Very often, the military formed (and still do form) their integrated logistics 'forms/structures/shapes' (guided by their history of successes and experiences which are encapsulated in their doctrine(s)) purely to support/supply specific incidents like battles/wars/campaigns and policing roles; these military logistics structures are then closed-down after the event. The business sector only comparatively recently (i.e. in the second half of this, the 20th century) picked-up the logistics integration *gauntlet*. The integration process for the business community has been enabled by communication and computerisation technologies supported by relationships. Generally, over recent decades, there has been a computer technology convergence in the logistics of both sectors - and although commerce is leading in its use (the connectivity aspect), paradoxically, the military sponsored the development and established most of the electronic communication/transmission technology in question.

12.2.3 Contribution Three

From both the literature survey conducted and the data collected for this thesis, the model or tabulation of "What is logistics?" by Rider (1970:115) has been revised, updated and refined (see the original in Table 2.1 (page 20) and the modified/updated in Table 11.4 (page 269)). 'Order Processing' has been added to the business function 'set of work functions'; 'Consolidation and Consigning' (a part of military Requirements) has been added to the business function 'set of system processes'; and the Recycling/Reuse/Reclamation and Recovery components added into the 'socioeconomic function' row of the business and military functions respectively. The table shows that military logistics includes all of the business logistics elements. Military logistics still has the wider set of 'work functions' encompassing maintenance and facilities engineering and also the wider set of 'system processes' embracing conservation. Military Requirements, which are now considered to be partially equivalent to commercial logistics strategy formulation, including Consolidation and Consigning, are thus no longer unique to the military in totality and the new table points to more of a convergence between the logistics in the two sectors than was the case with Rider's original table.

12.2.4 Contribution Four

Hypothesis one stated: "With a prime emphasis on supply, there is no fundamental difference between military and commercial logistics". The similarities found between the two sectors' logistics were many - note the number of elements above the line on both sides of Tables 11.7 to 11.10 - and these are not in contention; both sectors use the same: tools of analysis; techniques of inventory control; the principle of unique product code; concepts of lead-time reduction; arrays of 'node and link' arrangements; challenges of forecasting spare parts needs; etc., etc. Therefore it is necessary only to concentrate on the differences found. As the categories chosen for comparison were: characteristics; principles and concepts; performance indicators; and dimensions, the principal differences within these will be discussed now. For the discussion, and as a reminder, the main differences are repeated here and tabulated in Table 12.1.

From Table 11.7 (page 277) the principal differences in characteristics of logistics between the two sectors are:-

The military do not know precisely when their surges are to take place - versus - *most* of the surges in business are known well in advance.

Predominantly manual data capture in the military - versus - largely electronic data capture in business.

Embedded 'mind-set'/culture in the military - versus - inevitable change state in business.

The military, naturally, have some mobile nodes - versus - only fixed nodes in business.

Maintenance is a military logistics activity - versus - an operations activity in business.

Some military philosophies/policies/practices cause operational efficiency debits - versus

	MILITARY LOGISTICS	BUSINESS/COMMERCIAL LOGISTICS
Different Characteristics:	Surges are sudden. Manual data capture. Embedded 'mind-set'. Mobile nodes. Maintenance is a logistics activity. Efficiency debits.	*Most* surges are known. Much electronic data capture. Open-minded about change. Fixed nodes. Maintenance is an 'Operations Management' task/activity. Optimal efficiency sought.
Different Principles/Concepts:	Huge inventories. User and source mobile nodes. Use of priority rules. Little use of electronic data. Military attacks/curtails enemy's logistics. Organisation/structure 'locked' in tradition.	Aim to minimise inventory. Fixed nodes for user and source. Scant priority rules. Vast use of electronic data and its transmission. Business competes against competitor(s) with logistics. Organisation/structure will be changed if appropriate.
Different Performance Indicators:	No revenue based indices. Very little useful cost data about logistics.	Distribution costs as % of revenue (Sales). Huge drive for the data retrieval and the understanding of logistics costs.

Table 12.1 The Principal Differences Between Military and Business Logistics.

- optimal efficiency sought in business.

From Table 11.8 (page 281) the principal differences in logistics principles/concepts between the two sectors are:-

Huge stock buffers held by the military - versus - low stock preference in business.

Military has 'user' and 'source' mobile nodes - versus - only fixed nodes in business.

Priority rules used by military - versus - scant priority rules in business.

Little electronic data used by military logistics - versus - much real-time electronic data used in business logistics.

Military *attacks* enemy's logistics - versus - business who *competes* with competitor's logistics.

Culture of tradition in military organisation/structure - versus - culture of change in business organisation/structure.

From Table 11.9 (page 288) the principal differences in logistics performance indicators are:-

No revenue comparative indices in the military - versus - distribution costs as a % of revenue (Sales) ratio in business.

Not much useful logistics cost data in the military - versus - huge drive and systems installed to obtain cost data in business logistics.

From Table 11.10 (page 292) there was no difference of any significance in the dimensions used by the logistics of the two sectors. Table 12.1 is a tabulated summary of all the above foremost differences.

12.2.4.1 Differences In Characteristics

In the characteristics row of Table 12.1: the military, generally, do not know when they will be deployed precisely and their surge handling/management activities can be - and usually are - sudden. For commerce, surges like Christmas etc., are known about with a precise date. (Sudden surges are encountered in business too, cf. the death of Diana, Princess of Wales example quoted on pages 229-230.) Electronic data capture is fine for businesses that operate from fixed/permanent nodes in the supply chain/network. Also, the fierce competition in the market-place prompts the author to postulate that: **the rate of change in the speed of data exchange is proportional to the speed of changes in the market, i.e. as the market changes, the speed of these changes drives the need for faster data exchange**. (A direct historical military parallel to this, is that as the speed of attack became faster (i.e. increased) century to century, and then decade to decade, this stimulated the need for an increase in the speed of communications. As the speed of attack increased, the speed of communication increased proportionally.) This perceived phenomenon and the recognition by businesses that discounts (and therefore lost margins) offered on unsold clothes, fashion items and other short product life cycle goods, are the costs of inflexibility and poor responsiveness to consumer demand, and are the reasons why commerce is seeking 'end to-end' information management, backed by state-of-the-art technologies. This is not a realistic proposition when the nodes of the chain/network have to decamp and its operators have to move on or retreat: the mobility factor is of prime importance to the military. So, for the military, the use of electronic data capture and transmission presents feasibility problems associated with its mobile nodes. The technology and associated systems are probably available for the military should they wish to employ it, (the author is aware of trials being conducted by the military with barcoded ammunition supplies) but the moot point for discussion is: "How far downstream is it plausible to use electronic data capture

and transmission?": probably, no further downstream than a Divisional Support Area (DSA) or, the safest downstream-most ammunition control point (ACP). This does not mean that such a restricted policy should be applied to all supplies - *inventory segmentation* could be conducted/carried out; i.e. it is possible that other non-ammunition supplies/materials/inventories/stocks could be electronically tracked along the supply chain/network to the point of consumption. Probably, aspects like food, medicines, clothing and batteries, etc. could be tracked to the point of consumption giving little, if any, advantage to the enemy should matters go awry. Also, for security reasons (particularly for ammunition), the military would most likely have to continue with a parallel robust manual system which would come into effect should the electronic system fall into the hands of the enemy (or fail for any other reason). Given this scenario, why not *just* establish a very solid and rigorous manual system that everyone is trained to use? This is exactly what the military does. At the extreme upstream end of the supply side for military acquisitions and purchasing, there is no logical reason why it should not use Electronic Commerce (EC) - on-line ordering, indeed, the US military do, and are encouraged to do so, because it saves money.

Embedded 'mind-sets' and traditional cultures in the military, and the barriers they present to potential betterment, are acknowledged by itself. Change management education and practices are now being sought by the military to help to *"unfreeze"* (from Lewin (1951) whose three stage change model was: *unfreezing*, *changing*, and *refreezing*) itself and to view necessary changes objectively. An example to illustrate how business has changed over the years, is the fact that it has accepted that its trading role has changed and therefore it has moved away from negotiating low prices with its suppliers, to ordering, or calling-off, just the right amount/quantity required. The commercial sector finds out what is needed/required - objectives/policies first - and then organisationally structures itself such that the participants in the structure are *enabled* and *allowed* to deliver those objectives/policies. The military, on the other hand, organisationally structures itself first (or has an inherited structure which is difficult to change), and then tries to fit the objectives, principles and processes within that structure. Another business example of recent change in attitudes, borne out by this research, is the way/manner in which associations/consortia/cooperations/partnerships are managed. Whilst there is contractual solidarity underpinning the link, there is *flexibility* in the relationship and its continuity, or duration, is viewed on/as a long-term horizon by both parties. The previous/old approach (a 'mind-set') was one of short-term, traditionally adversarial, arms length management and orders/instructions just flowed one-way, from the customer/client to the provider. Indeed, the dimensions and measurement of relationships (in and around logistics) would be a recommended area for further research.

The mobile node aspect of military logistics, particularly related to land/ground warfare and soldier involvement, is just a fact of warfare life. The military recognises this and has all the experience in this facet, particularly for providing the necessary hygiene,

sanitary, laundry and medical support/facilities for the soldiers in almost any environment and terrain. Maintenance is a logistics activity/task for the military; in business it is managed by the Operations Management function. However, as this research is primarily associated with 'supply', this maintenance issue can be left to one side. The military acknowledges that the implementation of some of its logistics policies - like distances between warehouses/storage sheds and 'three points dispersal' storage (in M3, M4 and M5) in order to have some of the buildings/stock survive should an air raid occur - results in a loss of operational efficiency, but, they consider this a small burden/price to pay for the potential benefit that may accrue. (The author has been employed by companies that have operated from many (i.e. split/separate) sites/locations and the inefficiencies caused by such an operation had to be kept/managed to the minimum - just as the military do.)

12.2.4.2 Differences In Principles/Concepts

Turning to the differences in principles/concepts, the first one is the matter of inventory/stock quantity. The huge inventory holding practised by the military is partly historical, partly experience based and partly due to its need for flexibility. The military possesses the perception that flexibility is only granted by large/sufficient stocks and it gives endless quotes/examples of where successes occurred purely because stocks were there and available. The altering of, or persuasion to change this view is not an overnight affair; confidence in alternatives and perhaps demonstrated reality/experience will have to be developed to win advocates. However, from the last Strategic Defence Review (SDR) - announced in July 1998 - one of the intentions of the MoD was to seek opportunities to reduce its inventory holding; this is a courageous start. In business, with the expensive cost of materials today, and better opportunities for investment in other issues/matters, tied-up capital in stocks is an opportunity cost that normally brings low returns; not to mention the adverse effect it has on the RoI ratio. Mobile nodes for the military is fairly unique, but land/ground war is about *movement* and that means mobile units/nodes. Having spare parts supplies from mobile stores that follow behind the fighting arm is a solution that reduces lead-times for equipment repairs in the field, and must have proved beneficial many times. In the civilian domain there are some mobile 'source node' examples, like the: rural 'mobile library'; ice-cream van; mobile shop/mobile 'fish and chip' van; and 'door-to-door' selling.

One of the most noticeable differences in principles/concepts is the matter regarding 'priorities'. The military logistics supply operations policy is governed by rules of priorities (and sometimes associated allocations (from M4)), whereas only in exceptional circumstances will priorities and allocations be applied to customers in the practice of commercial logistics. It is the author's belief that this topic would be a fruitful area for further research. It would be interesting to investigate: "What is/are the "effect(s)" on logistics management caused by having priority rules versus not having priority rules?" Does this make military logistics management easier or more difficult than commercial logistics management? A possible null hypothesis could be: 'There is no effect, positive

or negative, on logistics management when priority rules are in use.'

The differences associated with electronic data capture and transmission were dealt with above under the differences in characteristics - the same arguments apply here. One point worthy of note is the fact that in commercial logistics, the need of real-time data is essential for lead-time reductions and to be able to offer a competitive response (both package and bundle). IT/IS systems associated with logistics was one of the supporting parts/areas of logistics that case study participants disallowed/barred the author from investigating/researching because this is held to be crucial to their competitiveness, responsiveness and efficiency. Indeed, having mentioned competitive response, businesses today compete against each other with logistics. This is another principal principle difference: the military will attack and/or attempt to curtail its enemy's logistics thus reducing his ability and capability to do harm. Loosely, given the previous sentence, it could be said that *military compete on logistics too* if the 'aim of the game' is to eradicate one's enemy's supply/support system(s). The issue regarding the change culture and its impact towards organisation structure was dealt with above in characteristic differences.

12.2.4.3 Differences In Performance Indicators

Both sectors acknowledge that poor performance is a symptom and its cause has to be sought and eradicated, hence the need for performance indicators. As the military does not have any 'Sales' as such (excluding income from any surplus supplies that may appear periodically to be sold to/in the private sector), so its accounting focus has always been on 'spend accounting' because of its obligation(s) to report to parliament for its use of monies from the public purse. Hence, there are no 'Sales' related ratios for the military such as the distribution costs to Sales ratio (or %), as used by business. In fact comparable performance measures between military and business are hard to find. Out of the five possible ways to measure the performance (and value) of a business: assets base; profitability; market value (i.e. share price or shareholder's value, if a public quoted company); cash flow; and future options, the only common one to both sectors is assets base. Therefore productivity measures like utilisation level, efficiency and achievements per amount of assets (i.e. productivity), e.g. 200 tonnes moved 100 miles with X number of 15 tonne trucks per day; and process comparisons/benchmarks with their outcomes of time reductions/compressions, quality and service levels/satisfactions are about the best that can be used. In the past, the military have not collected very much data/information regarding the costs of logistics; nowadays, this is changing; the costs of logistics are being investigated and discussions on what information is needed and how it should be collected are taking place. Business has generally obtained data on logistics costs but not in sufficient detail, but the current trend is to clinically dissect the costs of logistics with the aim of finding out the logistics cost per item.

12.2.4.4 The Outcome

Clinically, this first hypothesis should be rejected, *but* it can be accepted with caveats/provisos. Most of the differences above are contextual in nature (also some common aspects can be found as parallels in the other sector), and peripheral, rather than key or basic. In the areas where military and business logistics both have the same functions and processes, there is no fundamental difference between military and commercial logistics from a supply perspective - they are about minimising operational risk(s), excluding the priority rules, mobile nodes, lack of electronic connectivity and some operational efficiency loss aspects associated with the military. Therefore hypothesis one is accepted with the proviso, or caveat "excluding priority rules, mobile nodes, electronic connectivity and some inefficiencies by design". Therefore, with a prime emphasis on supply, and where there are no priority rules, no mobile nodes, no electronic connectivity and no designed operational inefficiencies, there is no fundamental difference between military and commercial/business logistics. As the military move towards electronic connectivity in its logistics, the convergence towards commercial logistics will be greater. Also, a generic conceptual model for logistics planning was developed - Figure 11.4 (page 298) where a conclusion can be drawn that, the 'logistics role and/or task' is to *link/tailor/bespoke* the 'logistics structure/infrastructure' to the 'demand mix'. The demand mix is composed of: lead-time (speed of delivery), cost, information, speed of communications (connectivity), relationships, quality, contact manner (contactivity), service, and after-service. Extensions to the generic logistics model delineating the benchmarking facet employed by the commercial sector were added - Figures 11.5 (page 300) and 11.6 (page 301). All the outsourced arrangements by businesses in the commercial set of case studies differed. Each arrangement was *tailored* to the circumstances and preferences of the client concerned. It is a viable proposition for the military (i.e. Army BODs, and others) to emulate this model. Some military logistics operations could be outsourced with tailored and preferred arrangements, and others could be kept in-house, thereby affording a similar benchmarking configuration - this would be, in fact, a *real* comparable kind/type of *Market Testing*, which became attractive to the MoD during the early 1990s, but it was generally considered impracticable, due to a lack of resources to collect the data, hence to conduct *meaningful* comparisons.

12.2.5 Contribution Five

The second hypothesis for this thesis is: 'Both military and commercial logistics systems can be analysed and compared according to four distinct logistics types' (as depicted in Figure 8.1 (page 226)). The 'Logistics Types' model hypothesis has been found to work and been operationalised; it gained acceptance and had credence in the case study communities that were used for this thesis (with the exception of one commercial interviewee - a C6 interviewee who did not entertain the model because he said he knew nothing about military logistics and therefore, would not even look at, or consider, the model - an explanation for this might be that the *psychic distance* was too far to

bridge/cross for the interviewee). Sufficient examples (at least six per quadrant, excluding Responsive Logistics in the commercial findings) were located appropriately for both the military and commercial areas, see Figure 11.7 (page 302) for the military analysis and Figure 11.8 (page 306) for the commercial analysis. It appears that outside of the apparel/clothing industry, the proper QRL model explained in Chapter 6 is relatively unknown. Therefore, hypothesis two is also accepted and it most probably could be generalised.

This research was conducted via a rationalistic epistemology which lies at the positivistic end of the philosophical research spectrum. Whilst for many positivistic research approaches quantitative data are employed, unusually the data obtained/collected for the two hypotheses attestation judgements in this thesis (i.e. contributions four and five above) were qualitative. The findings from data by way of a primary research conducted via case studies, were generally confirmed by a secondary research conducted by historiography - in general, the same conclusions by two different methods.

12.2.6 Contribution Six

In the context of a switch in defence thinking and the development of a related new military logistics doctrine, it is possible to transfer some of the business/commercial practices into its domain and retain flexibility. The first of these is supplier base rationalisation where a smaller selected base of suppliers would: reduce the number of points of contacts; reduce transaction costs; result in a lower unit price, particularly of consumables and high volume items; and eventually culminate in Electronic Commerce (EC). The second is supplier integration (or partnership sourcing), where 'open-book accounting' and the development of long-term relationships, trust, information sharing, clear mutually agreed objectives, and total commitment is sought between the MoD and suppliers. The third is a move towards more JIT and lean supply approaches - meaning less assets (chiefly inventory). Indeed, a modern administrative avenue being explored by the MoD is the idea of placing a *charge* on assets (a kind of asset levy), which will encourage the practice of *getting more* out of *less* - decreasing the asset base. The fourth is the encapsulation of quick response logistics techniques including the electronic connectivity aspects and partnerships employing modern methods like supplier/vendor managed, and/or co-managed, inventory/stocks/parts. The fifth is benchmarking with industry/business/commerce by outsourcing a large proportion of the logistics up to (i.e. not including) the close support role, but keeping the balance in-house, for direct comparisons to be made (and internal training reasons, so that any future scaled-up activities could be handled in-house, should they be necessary). Hence, process, quality service, and image improvements can be made with a substantial cost reduction outcome. The commercial sector has already benefitted from many developments which were sponsored and encouraged by the military. Commerce could probably learn some lessons from the military with regard to international/global logistics.

12.3 General Comments About Military Logistics

It is recognised that a political party in power is conscious of its *political appearance* and the message it sends to the public can be 'dressed-up' to improve that appearance. Naturally, defence, a service provided by the government, can be treated as a political football depending on the friendliness of the global climate. However, this thesis has ignored the political dimension of defence and remained in the realms of objectivity and rationality with regard to military logistics. The first step to making substantial savings in the MoD via military logistics is to centralise logistics for tri-Service supply and support. Vast overhead savings can be made and operational savings from the economies of scale would be realised. In addition a common, uniform set of processes and systems could be established throughout the MoD instead of the manifold varieties that currently exist in the different Services. Also, a rationalisation of MoD suppliers would simplify matters - with fewer points of contact - as well as enabling price reductions. The MoD has over 30 000 suppliers of which circa 13 500 are the key/main/essential ones. The annual purchases by the MoD Procurement Executive (PE) are of the order of £8.5 billion. For example, PE purchases wooden pallets from nine suppliers currently; if, for example, the suppliers were reduced to four, the larger volume purchases from each supplier would result in a unit price reduction because of the volumetric economies of scale that each of those four suppliers could then achieve.

The military logistics concept is all about *concurrency* and it splits into 3 types: Acquisition (the Procurement Executive (PE) in the MoD); Consumer; and Operational. Opportunities exist in all three types for commercial involvement/assistance/participation and the principles, experiences and practices in the management of suppliers from the private sector could, and should, be transferred to the MoD. With Acquisition, the emphasis is on working closely with OEMs and main suppliers to influence equipment design(s) - using ILS and LSA. Having established and identified the 'trade-offs' in those designs, good decisions can be made as to which options to take/buy, and which to decline.

The Consumer type is about 'everyday life', the food, clothing, parts/bits and supplies needed for normal subsistence. Asset (mainly inventory) tracking is essential, and apart from ammunition, this could be employed right up to the point of consumption using the established electronic connectivity tool-set. For ordering, 'on-line' ordering and Electronic Commerce (EC) will be a much cheaper process (i.e. circa 75% cheaper than telephone ordering). For spares/parts, once the core strategic requirement(s) has/have been defined by, or in, the Equipment Maintenance Policy Statement (EMPS) - which defines the level of service, repair and availability required (particularly in peace-time) - commercial partnerships and outsourcing can be considered and taken on-board. Benchmarking can then be used versus oneself (i.e. MoD) and versus other partners and/or outsourced suppliers/service providers as depicted in Figure 11.5 (page 300) and

when more than one is used Figure 11.6 (page 301), just as it is used by businesses. Co-Managed Inventory (CMI) is a possibility as well; CMI is a form of vendor managed inventory (VMI) which would involve an active collaborative approach between the supplier and the MoD as partners. They would both share responsibility for inventory management in a way that would combine the expertise of both parties, with an objective to maximise supply chain/network efficiency (i.e. reduced costs and fast response/reaction times) for the mutual benefit of both parties. For the Operational type, once the *graduated readiness* criteria have been defined, the appropriate commercial *modus operandi* can be instituted using 'dormant contracts' and/or 'retention fee arrangements' for their congruous input(s); this is sometimes called: logistics commercial aided programme (LogCAP) and there is also CRIPs - Crisis Resupply from Industrial Procedures - which can be/is used in/during emergencies/unforeseen events/circumstances, etc.

In the military, because of the wide scope and scale of what it has to do, it is necessary to plan and have designed supply networks and chains as well as having the unusual (e.g. a logistics scion - and pruned when necessary) that is appropriate to the situation. There is also the concentration versus dispersion argument/debate - here a balance is needed. Very often, the constants of/in one situation/circumstance of military logistics must be/or are treated as variables in another - hence different types of logistics as displayed in the matrices of Figures 8.1 (page 226) and 11.7 (page 302). Whilst planning and system design for military supply and logistics is imperative, it should not be thought that those who fail to do this in an organised/systematic way/fashion are doomed. History is mottled with examples where the use of the terrain and peoples' commitment/fanaticism (hence their creativity and innovativeness) were probably more key in guerrilla type warfares than having access to materials/materiel.

Defence is a service provided by the government and logistics is a service to defence, so maybe service sector measures could be used like: 'idle capacity', which is the service sector's equivalent to 'product inventory' in manufacturing - only in defence logistics there exists both idle capacity, which is the insurance underwritten should it be needed, and the inventory problem of the WMR stock-pile. The other service sector measure that is used to compare services to manufacturing is the labour intensive to capital intensive ratio. Whilst some years ago, an argument was made that one of the differences between services and manufacturing was that the labour intensive to capital intensive ratio was higher for services than it was for manufacturing, the situation today is that they are both converging. Also, with the advent of 'bundling', product aspects, service aspects, and the way business is done/conducted, are converging/merging. It also looks like a combining of operations management and logistics is taking place too (the same convergence is happening in businesses as well), which is necessary if a true seamless demand chain is to be established.

12.4 General Comments About Business/Commercial Logistics

There is no doubt that interesting times are ahead for composite distribution centres. On-line computerised data analysis will be designed to enable the data to be *'cut'* in many more ways; for instance allowing multi-store item picking to take place instead of the present single store picking (from C4). This would enhance efficiency/productivity and reduce the movement/number of 'in/out' trips to the same storage areas. Also, multiple product deliveries with 'one drop' (perhaps with a reduction in traffic jams and a 'Green' benefit) will become common by using multiple compartmentalised vehicles/trailers, which will enable the whole temperature range of foods to be carried together, as well as foods and non-foods (from C1, C4 and C7). Assets sharing will become more prominent - multi-user warehousing and shared transport fleets, etc. For the future: greater *power sharing* (i.e. true partnerships/alliances) will be the norm in business relationships. New forms of work contracts for employees (like 'annualised hours' coupled with 'agency staff' for large 'peak-lopping') are likely to cope with the on-set of seven days a week shopping - and possibly, 24 hours per day shopping in addition. With the modern day millennium life-style, home deliveries of groceries - just like the present day department store purchases - may be making a 'come-back' on a large scale. Indeed, the way we shop will be different, like: telephoning orders to a shop/supplier and having home deliveries will generally increase; shopping via personal computers linked to the internet - i.e. from on-line catalogues; and digital interactive television - i.e. live video conferencing. (The mundane and regular/standard shopping will have the drudgery removed by these methods, thereby leaving more discerning time to spend (and perhaps, to enjoy) on the shopping for 'higher value items'.) This set of shopping methods means that more jobs will be created (and hence more people needed/required) in central (i.e. uni-centric) warehouses/stores to carry out the work of: order processing; selecting/picking; packing; and delivery (i.e. drivers). It means that management, supervisors and team-leaders will need to be very strong on/with 'people skills'.

We are probably entering an era which is likely to be known as the 'Knowledge Economy'. There will probably be more customisation and consumer tailoring, and thus the allocation of 'customer specific product coding' - just like Levi's tailored jeans (from C6). In, or when the value comes from, a 'Knowledge Economy', an individual, or an entity, cannot control everything (i.e. matters cannot be controlled hierarchically) - therefore partnerships/relationships and devolved empowerment helps and assists in this situation, provided the right and proper training/education has been given to staff. What this alludes to is *Intellectual Capital* which is the addition of: *Human Capital* plus *Structural Capital*, see Figure 12.1. Human capital consists of knowledge/education, training and personal qualities like leadership and, coping well when a high level of customer contact is required; and structural capital consists of IT/IS networks/systems and computers, data-bases/knowledge-bases (where *textual searches* can be conducted) and the organisation's packaged *unique* processes (in total forming: smart-systems)

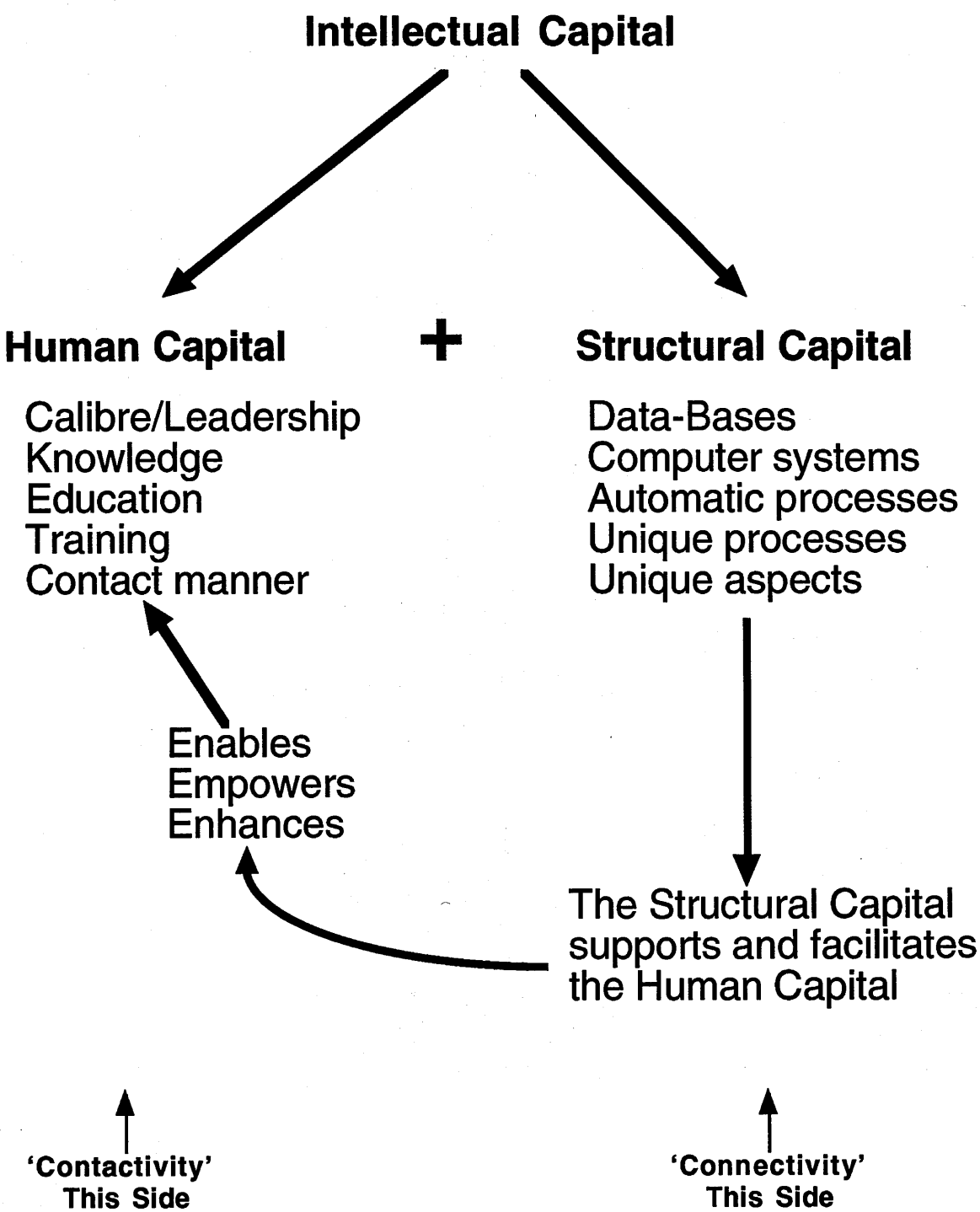


Figure 12.1 Intellectual Capital: Its Components and How it Works

which are very difficult to copy or emulate by competitors. In essence, it is to do *something different*, not just to do *something better* (see Porter, 1997:23). (It was for this reason that some of the commercial case study participants in this research disallowed the author from seeing, inquiring, learning and understanding their structural capital - which, quite rightly, they saw as their competitive advantage and they wanted to retain this differential benefit for as long as possible.) An issue that faces many companies and their service providers is the *ownership* of gathered information/data, and with product/service *bundling* becoming more widespread (Rayport and Sviokla (1994:141) informed: "Most important, the information about a product or service can be separated from the product or service itself. In some cases, it can become as critical as the actual product or service in terms of its effect on a company's profits.") the data ownership debate (indeed argument) is unresolved. It is the structural capital - i.e. connectivity - that *leverages* the human capital - i.e. contactivity. This is all about enhancing 'enablers' and reducing 'inhibitors', which is not easy because the characteristics of intellectual capital are: it is invisible; it cannot be accurately measured; it is very difficult to value; and it probably *cannot* be *effectively* managed. However, intellectual capital is a necessary platform for the ability to transform knowledge and intangible assets into wealth creating resources for commerce/business and successful, cost effective logistics (defence logistics too).

Reality must be faced; customers have views, thoughts and real needs. To deliver those needs, provide the appropriate service and match customer satisfaction at the point of delivery/contact, means taking account of those customers' views/needs/preferences, perhaps by data captured for customer profiling and consumer fingerprinting (the author feels that, so far, not much work has been done to analyse properly, this type of captured data - i.e. data warehousing and data-mining). Business logistics is very much a service; it enhances/embellishes/augments the product(s). In the past, an enterprise used to have a 'loose strategy' and 'tight controls' which did not allow the front-line staff, who are in contact with the customers, much room to manoeuvre. Today, it is necessary to allow, and have, a work force that possesses 'degrees of freedom' to respond to the circumstances appropriately and as necessary - i.e. an empowered work force. To generate, and encourage a real/true empowered work force, that will furnish the appropriate service and improve customer satisfaction at the point of delivery/contact, requires a 'tight strategy' and, 'loose controls' on implementation. The enterprise has to be clear about, and, understand what it wants and then communicate the strategy to its employees. It should *grow* and *stretch* the *core* - i.e. the people; and develop robust processes/systems that support them. Commitment from the employees will follow once they understand the values and beliefs of the organisation and observe them in action.

Contact with many people during the course of this research work has led the author to conclude that for the 'millennium computer compliance/compatibility' (i.e. Y2k) problem, many businesses - particularly in the factors of production (i.e. business to business) markets - have plans afoot for stockpiling to take place. This is a very telling

example of how dependent on IT/IS business has become and when this is vulnerable, reliance on the good old practice of stockpiling takes place - just like the military; it becomes acceptable, in spite of the cost(s). Clearly, every organisation/enterprise likes some form of insurance.

12.5 Last Comments - Aperçu

Many wars/battles/conflicts were fought because of commercial logistics; that is, wars were fought in order to have access to a raw material supply, etc. Just consider how the lands which are rich in mineral resources seem to be the areas where wars/conflicts appear to fester. Many examples can be given:-

- The Indian Wars (1622-1890) of North America were fought because of three reasons:-

1) The white man wanted access to the 'Black Hills' in Dakota and other Indian areas in order to mine for gold, silver and copper, and to settle, whereas the Indians wanted to retain their lands (compensation claims by many Indian tribes are still pending);
2) The white man wanted to cross Indian lands with railways and to settle, whereas the Indians wanted to prevent this mass invasion of their lands;
3) The white man wanted to (and indeed did) conduct mass slaughter of the buffaloes for their skins/hides (these fetched good prices and hence profits) whereas the Indians wanted the buffaloes preserved as the herds provided the principal form of their staple diet, food and some clothing and tentage.

- The Boer War (1899-1902) had its origin in the grievances of the Outlander (foreign) population, who were mostly British subjects, and who were refused their share of political (i.e. voting) rights; while they owned most of the property (where the gold, copper and diamonds, etc. were mined), they had to bear the major part of the taxation - taxation without representation.
- In 1937-1941 Japan, who was (and still is) deficient in almost every resource, wanted, and tried, to take possession of the productive regions of China.
- Biafra - the civil war in Nigeria (1967-1970). Biafra, the south east province of Nigeria, possessed very nearly all of the Nigerian mineral resources - chiefly oil; under Colonel Ojukwu it attempted to break away from the Nigerian federation. Nigeria could not afford to let Biafra have its independence as the future wealth of the federation depended on the mineral resources (particularly the oil) in Biafra.
- The Falklands conflict (1982) was probably defended in the vigorous manner it was because of the known oil reserves within the proximity of the islands.
- One of the contentious issues in the Jordanian, Syrian and Israeli conflicts of today is the access to, and control of, water supply, i.e. from the River Jordan.
- The Gulf War (1991-1992) came about because Iraq wanted the Kuwaiti oil fields for itself, whereas, it has been suggested, the Western powers did not want Iraq to have further control over the flow of Middle-Eastern crude oil. (As a British politician said: *"If the Kuwaitis grew carrots, we would not have intervened!"*)

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14. APPENDICES

"Great literature is simply language charged with meaning to the utmost possible degree."
From "How To Read" (1931) by Ezra Pound (1885-1972)

Case Study Content Page No.

Commercial/Business Sets (cont'd)

14.1 The South African (Boer) War 1899-1902 - (Case Study - M1)

Two wars were fought by the British and the Boers for the mastery of South Africa. The British had made several attempts to re-incorporate the Boers (who left the Cape Colony in the Great Trek north across the Orange River in 1835) within a South African confederation. The first Boer War (1880-1881) ended with the defeat of the British at Majuba Hill, and the signing of the Pretoria and London Conventions of 1881 and 1884 respectively. In December 1895 - January 1896 the Jameson Raid was a clumsy private effort to achieve the same objective as the second Boer War. (The Jameson Raid was an expedition against the South African Republic, which was supposed to link up with a revolt by White workers on the Rand and topple the government of President Kruger. Leander Starr Jameson (1853-1917), administrator for the South Africa Company at Fort Salisbury, led a detachment of British South Africa Police into the Transvaal, but they were easily defeated and arrested. As this *Raid* failed, the British government distanced itself from anything to do with it. The German Kaiser, Wilhelm II, sent a telegram of congratulation to Kruger, and the incident caused a major government crisis in Britain as well as contributing to the tensions that led to the second Boer War.)

The second Boer War (1899-1902) can be divided into three phases:-

(1) October 1899 - January 1900: a series of Boer successes, including the sieges of Ladysmith, Kimberley, and Mafeking, as well as victories at Stormberg, Modder River, Magersfontein (where the British tried to advance in/during a thunderstorm), Colenso, and Moderspruit. (In this phase the British did not conduct reconnaissance, had poor/bad communications and inadequate supplies. When the British first deployed for this phase of the war they treated it as a *hunting expedition* as many politicians and soldiers thought the war would be won, and over with, by Christmas 1899. The British garrisons in South Africa had cannons with ranges which were insufficient compared to the German and French cannons the Boers had in their possession.)

(2) February 1900 - August 1900: counter-offensives by Lord Roberts of Kandahar, (i.e. Sir Frederick Sleigh Roberts) including the raising of the sieges, the victory at Paardeberg, and the capture of Pretoria.

(3) September 1900 - May 1902: a period of guerrilla warfare when Kitchener attempted to prevent the Boer commandoes raiding isolated British units and their lines of communications.

In 1886 gold was discovered on the Witwatersrand and the Transvaal Republic became the richest spot on Earth; it soon accounted for a quarter of the world's gold supply, (£24 million per year was the gross value of the gold revenues). A very important event for the Transvaal republic occurred in 1895 when the railway was opened up with Portuguese East Africa in Mozambique, to an independent port Delagoa Bay (called Maputo today), which enabled the Transvaal (and its sister Republic, the Orange Free State) to be independent of the two British Colonies (i.e. Cape and Natal). Supplies could then be obtained from independent sources via non-British territories; previously all supplies were transported from the sea-ports of the Cape Colony up country to the Transvaal. Due to these events, the political and economic power in that part of South Africa moved from Cape Town (under the British) to Johannesburg and Pretoria (under the Boers). The Boer government started to impose high taxes on vital mining supplies, such as dynamite. As a result of gold mining, Uitlanders (Outlanders or foreigners), mainly British, had quite a lot of economic power as they had become quite rich, but were not allowed democratic voting rights in the Transvaal. Their counterparts, i.e. the Boers, who resided in the Cape and Natal Colonies, did have democratic voting rights as residents. This 'cocktail' of events and power switch led to the Boer War of 1899-1902. The enemy for the British here was of north European origin and, as such, differed from their enemies here with whom they had engaged with (e.g. the Zulus) in the preceding four decades. With their gold, the Boers bought/purchased an arsenal of the latest

weapons from Europe: Mauser rifles (which contained magazines) and Krupp field guns from Germany; as well as Creusot siege guns from France. Each Boer supplied/bought/obtained his own horse and his own rifle.

For the British, four times as many troops as in the Crimean War were used and it cost three times as much in money. (It was a Colonial war and by far the most important such war fought in the hey-day of the British Empire. It was the greatest of the wars accompanying the new Imperialism and the European scramble for Africa.) The full might of the British Empire was deployed and by March 1900 some 200 000 British and Empire troops were involved in a war in South Africa against Boer forces who fielded no more than 45 000. A war which the British government had expected to cost no more than £10 million, involve at most 75 000 troops and be over in 3-4 months, eventually cost: over £230 000 million, (cf, £70-£75 million for the Crimean War), involved a total of 450 000 British and Empire troops and lasted for 2.5 years. When the war began on 11th October 1899 there were only about 20 000 British troops in South Africa; the Boers were able to mobilise over 35 000 on commando. The Boers invaded the Cape Colony and Natal, but soon became bogged down in laying siege - with their long range German and French cannons/field guns - to Ladysmith (for 118 days), Mafeking (a market town on the railway) and Kimberley, all of which held out - by not sharing the limited food with the Black Africans - until successfully relieved several months later. The Boer commandoes also ambushed British trains and blew-up bridges to both halt the British advances and to steal the supplies. By the end of December 1899 massive British reinforcements had been sent out to South Africa. (Ladysmith was besieged by 16 000 Boers on 2nd November 1999, in an investment only lifted on 28th February 1900. The Boers split up, establishing a front of about 5 000 men along the meandering Tugela River, guarded by the heights of Colense, the Tugela and Spion Kop. To smash through this 40 km mountain barrier to relieve Ladysmith, the British commander in Natal, Sir Redvers Buller, with 22 000 men, fought four bitter battles: at Colenso (15th December 1899), Spion Kop (22nd January 1900), Vaal Kranz (5th February 1900), all of which the British lost, before the assault on the Tugela Heights, from 14th to 28th February 1900, finally raised the siege. Poor Sir Redvers, who earned the nickname of "Sir Reverse" because of his early defeats, had no easy task to capture the heights (which Allied veterans of WW2 would find strongly reminiscent of the mountain barrier at Cassino on the road to Rome).)

When the three towns were freed and after the Boers in that region surrendered at Paardeberg (on 27th February 1900, a battle at which around 2 200 British soldiers were killed (the most in one battle of the Boer Wars) where Lord Roberts had to surround/flank them, such that within eight days the Boer's Commandant Cronje capitulated with 4 000 men), the way was open to Bloemfontein (the capital of the Orange Free State). A further advance across the Vaal towards Johannesburg, however, was delayed for almost a month because of an epidemic of typhoid (enteric fever) amongst the British troops. The disease was endemic in South Africa, but it spread like wildfire due to insanitary conditions in the British camp because they economised with medical care and due to general negligence. Field Marshall Roberts was poor at the daily requirements of military administration and failed to delegate the necessary tasks to competent staff. (Deaths from wounds and disease accounted for three-quarters of British losses in this war, and a substantial number of them occurred in the typhoid (enteric fever) epidemic after the occupation of Bloemfontein as a result of the Boer's General De Wet's ambush at Sanna's Post. By this *coup* the waterworks and its flow fell into the hands of the Boer General; the consequences of that unlucky day were seen in thousands of cases of enteric fever (typhoid) that struck down the the British army around Bloemfontein.) With the occupation of Bloemfontein (thus clearing the railway line from the Cape and which allowed for the making of secure lines of communications, thus enabling the bringing up by rail horses, mules and stores), Johannesburg and Pretoria, the formal phase of the war came to an end, but the only real aim of the Boers was to prolong the struggle. It became

the first of the twentieth century's guerrilla wars.

At the (hinge) turn of the century (1899-1900) this war exhibited features of both traditional and modern warfare. It presented the British with unprecedented problems of how to equip, transport and supply the largest army the British (and possibly the largest in the world's history at the time) had ever sent overseas and enable it to fight nearly 6 000 miles away from home. It was a war which revolved around railways, steam-ships and horses. The War Office reckoned that 400 346 horses, mules and donkeys were used by the British Army. Not only Britain and South Africa, but East and South Europe, Australia, and South America were scoured to find horses which had then to be shipped to South Africa. Some British soldiers complained because many of the transported horses were not immediately usable. The horses were obviously fatigued, frightened and debilitated from their ordeal of being transported for many weeks, across rough seas, etc. and needed a period for recuperation. [A South African friend of the author told him that his grandmother (who was in the siege of Mafeking) relayed to him how the British immediately trained their new horses to muster to the sound of the bugle; this was because the Boers would steal horses at any opportunity, and by sounding the bugle the horses would turn round and return home.] The huge effort to supply horses was not paralleled by their fodder supply and many horses/mules died simply from a lack of feed. In South Africa steam-engines and oxen were used to haul wagons over dusty tracks and through fords in rivers thus allowing most of the horses to be employed for combat and military purposes.

At about the same time as Pretoria was being liberated, General Sir Redvers Buller in his forward movement drove the Boers north; he cleared Natal and occupied Laing's Nek; then by means of the railway opened up a new channel of supply for the army of occupation, which by this time (April-May 1900) numbered close upon 250 000. Meanwhile, the little garrison at Mafeking, under the charge of Colonel Robert Stephenson Smyth Baden-Powell, which was still under siege, held out from the middle of October 1899, the inhabitants' rations having been reduced to horse flesh and mouldy biscuits - which were not shared with the Blacks. Mafeking was liberated on 4th May 1900.

Just as in the Crimean War, the military claimed tremendous disadvantages of relying on civilian organisations for the hiring of transportation. Carriages and carts were commandeered and put to new purposes, bicycles were used by messengers and a special railway 'war cycle' was designed to carry riders at 30 mph along the track. Air balloons were used for reconnaissance, signals were sent by semaphore, by early field telephones or by heliograph (the only disadvantage of which was its dependence on bright sunshine to flash messages across large distances). Huge amounts of supplies and large numbers of men (reinforcements) arrived at the southern port of Cape Town and had to be transported up country by train; the ports of Port Elizabeth and East London were used too; and so was the port of Durban for the relief of Ladysmith. (One British soldier commented in Cape Town on how he did not know the *"greatness"* of Britain until he saw the vastness of the supplies (munitions/equipment/wagon wheels/accoutrements/food/etc.) stored/stacked on the quaysides. Much of the equipment was transported in a disassembled (knocked-down (KD) or 'flat-pack' type stacking) fashion/manner to reduce its volume consumption in the ships' holds, thereby maximising stowage on board; assembly of these was conducted at the port of arrival. From the railhead, men marched for hours, days, weeks on end through a dry and mostly barren landscape and a fierce sun, stopping now and then to rest and inspect their feet. At night they were often without tents and slept on the open veldt or they made a bivouac out of a couple of blankets. Officers did rather better than the men, but conditions were very primitive by modern standards. The 1870 Education Act meant that there was a fairly literate soldiery, many of whom read, wrote verse (or worse) and sent letters home. At its peak, the Army Postal Service was handling 190 000 letters per week.

Mounted cavalry played a far more important part than in most subsequent 20th century wars but only gradually did the British learn to break up their large slow moving columns and baggage trains into smaller and more mobile units. Heavy artillery was used by both sides in the set piece battles and sieges of the first six months of the war, including converted naval guns on the British side. Trenches (i.e. fixed/static positions or 'nodes' were extensively used - because this made supplying the men easier - (trenches were dug by the Black Africans who were used as labourers by/on both sides) and trench disaster here gave a terrible forewarning of WW1. 1 100 British soldiers were killed, wounded or made prisoner at the precipitous height Spion Kop battle (22nd January 1900) in one day. When the British heliographic equipment was damaged in the fighting at Spion Kop the unit possessed an oil signal lamp as a contingency - but no one remembered to bring the oil, so it was rendered useless. On ascending the Kop during night-time the British soldiers tended to drop, or leave behind, their picks and shovels to lighten their load and to maintain/retain silence, so when it came to digging trenches in the very hard and rocky ground of the summit they had no tools; they made do with trenches of only 45-50 cm in depth - which proved fatal. The trenches on both sides here were dug mainly by the thousands of Black Africans who served the armies as labourers, transport riders, scouts, spies and messengers. Messages written on scrolls of paper were often stitched into the clothing of Black African messengers. Black Africans were also armed especially by the British and latterly in large numbers. Kitchener admitted arming 10 000 Blacks but the total was probably closer to 30 000 which was an estimate given by Mr. David Lloyd-George (later Prime Minister) at the time and who was a pronounced opponent of the war. Throughout the war, Army Engineers were kept busy repairing and extending telegraph lines and constructing pontoons to enable troops to cross rivers.

In one crucial respect, this was a decidedly old fashion war, because three-quarters of the British troops who died in it, did so from disease. The wounded had to be moved by cart and train, often for several days before they reached improvised hospitals in towns and cities. The British economised on medical care, so field hospitals were rudimentary affairs in makeshift buildings or tents. (In 1900 Dr. Arthur Conan Doyle (later Sir) was engaged as senior physician in the Langman Field Hospital; he was knighted in 1902 probably because of the pamphlet he published: *The Great Boer War: Cause and Conduct of the War* (1902), of which 100 000 copies were distributed.) Surgical operations were sometimes performed on the open Veldt. There was no penicillin or other antibiotics and anaesthetics consisted of chloroform dripped onto a pad which was held on the patient's face covering his nose/mouth.

In November 1900 when the command of the British Army in South Africa was transferred from Lord Roberts to Lord Kitchener many thought the worst of the war was over and that only a policing activity/role was left. This was not the case - a highly mobile Boer guerilla tactic ensued; Le May (1965:94) described it thus: "It was some time before it was generally realized that the war was not over, and that the Boer forces, broken up into self-contained and self supporting commandoes, purged of the weaker brethren, unencumbered by wagon-trains or artillery, were more elusive, if not more formidable than before." The vast tracts of country over which they manoeuvred and the mobility of the Boer forces enabled them to appear and disappear, to concentrate and disperse with a suddeness that was almost magical. In the latter phase of the war, Kitchener approached the difficult to police and control vast open space/area problem by treating it as a 'chess-board'. He established/constructed an extensive system/grid consisting of some 8 000 blockhouses (octagonal buildings in which each had a platoon of soldiers that lived-in it) along the railway line and in communication with its neighbour on either side. The blockhouses were connected by 3 700 miles of barbed wire fencing. Armoured trains scouring the lines were able to bring help when called for. This blockhouse network enabled the British to 'drive' the Boer commandoes into ever more restricted areas, thus eventually confining them. The Boers, on occasions, had a few successes at breaking

through these barbed wire fences by rushing or stampeding a herd of cattle at them. In addition to the blockhouse strategy, a series of forced marches and night surprises/attacks were conducted by the British. These forced marches and night surprises were so increasingly and successfully employed that the Boers would not bivouac within forty miles of the British troops - a circumstance which made the task of getting within striking distance more and more difficult.

The Boers on commando were perhaps one of the best examples in history of a citizen army. The Boers were crack shots and well armed - "As long as there are British forces in South Africa we'll have their arms and ammunition!" - was their famous saying. Often, a burgher would go into battle with only three rounds in his rifle, and would end up with two bandoliers full of cartridges and a British Lee-Metford or Lee-Enfield rifle after it. Many British supply-trains and convoys were victoriously ambushed by the Boers; the weapons, ammunition and supplies were thus taken and utilised for further commando raids/ambushes/strikes/hits. So, at the end of the war on surrendering, nine-tenths of the burghers laid down British Lee-Metford or Lee-Enfield rifles. It was early on during this war that the British soldiers changed their 'red-coats' to khaki coloured uniforms; the red colour was too conspicuous and thus helped the commandoes by being presented with ripe, noticeable targets for their terrorist/guerrilla sniping. Despite their greater numbers, the British were outwitted by the Boer marksmen. The British could not see the enemy who used Mauser (magazine) rifles initially. The British had superior numbers, but the unseen Boers would attack British positions and then disappear. Of particular target for the Boers was the interdiction/communication points like the railways, the telegraph lines, bridges and fords/spruits. This was a highly mobile war, and access to supplies of horses was a crucial factor in the ability to continue the war on behalf of the commandoes. Indeed, by the end of the war more than 30% of the Transvaalers were without horses; they were on foot and a war like this one could not be fought on foot, or with less than 70% of the men mobile. This type of war for the Boers meant: hit, run and hide; hit, run and hide again. So the lack of horses was a contributing factor to eventually signing the peace treaty.

The British needed to *starve* the commandoes of supplies. As farms were used by the Boers as military bases it thus brought civilians (i.e. the Boers' own families) into the war. In order to prevent the Boers from getting supplies from the farms, the British order given was: "Burn, destroy, remove!" During the guerrilla phase of the war, two features of British policy which came in for particular criticism were: the 'scorched earth' practices of burning farmhouses and the mass slaughter of livestock; and the herding of Boer women and children into concentration camps so that the commandoes would be without support in the field. (Concentration camps were the idea/invention of the Spaniards/Cubans; concentration camps were used in Cuba by the Spaniards for the first (recorded) time a few years prior to the Boer War.) These camps (which consisted mostly of Bell tents) were not given humane status and were *not* supported as areas where humans resided. As a result, about 28 000 of these Boer civilians died in these camps - mostly from infectious diseases due to insanitary conditions and negligence. This internment policy of the Boers by the British was attacked throughout Europe. (Whilst this internment policy was not condoned by the Boer commandoes, it actually assisted them by allowing them to focus on the war only, and fending for themselves only, as their women and children were not *immediately* dependent on them and consuming their food and resources.)

The Black Africans were also placed in concentration camps (but separate from the Boers) by the British to prevent them from providing the Boer commandoes with food and being used as their labourers (although the British used the Blacks as their labourers, particularly in the mines and for trench digging, also as scouts and, eventually armed them). The Black concentration camps were kept in a manner that was *worse* than the Boer camps - the Blacks had to 'live off the land' - and 14 154 deaths of Blacks were

recorded from the 115 000 who were interned and many other deaths *must* have gone unrecorded (Warwick, 1983:151). Indeed, current work-in-progress research is revising the number of deaths of Blacks in these camps to circa 30 000 - i.e. double the original known recorded. The internment policy of the Blacks received scant attention, if any at all, from Europe.

The total British deaths in the war was almost 22 000 - three-quarters of them from wounds or disease. On the Boer side the total was about 34 000 of which 6 000 were accounted for among those who fought on commando, the remaining 28 000 being civilian deaths (mainly women and children in the concentration camps; these sufferings and deaths were some of the strong eventual reasons that encouraged the Boers to seek peace). These figures may look modest by 20th century standards but at the time they were received as deeply shocking. About 10% of the Boer population of the two Republics died in this war. It is no surprise that by the beginning of 1902 both sides were ready to settle for a negotiated peace. This war was now costing the British £1.5 million per week and they were prepared to settle for less than an unconditional Boer surrender. The Boers had turned down a peace offer made at Middelburg in February 1901 on terms not dissimilar to those eventually accepted at Vereeniging over a year later. By April 1902 however, the British block-houses and wire had restricted those remaining on commando to a small area where there were severe shortages of food and horses, and the Boer commandos were subjected to increasing attacks by the African population. Also, there were sharply increasing numbers of defectors or *hensoppers* ('handsuppers' or surrenderers) and 'joiners' who went over, joined and assisted the British. At the end of the war a quarter of the Boers still fighting were fighting on the British side.

For the British, (and the Boers for that matter), the Boer War was totally decentralised; each Army officer had to acquire some resources locally for himself, e.g. in Johannesburg where all the British support staff resided, they had to organise the requisition of horses and nobody had any experience at all. Also, the Army in this war was scattered all over the place - how do you get the stuff to them? How do you organise a logistics chain to support a unit 5 miles out in the bush/veldt? If you run out of something how do you get it? None of this had been thought through. There was a total lack of planning. In the rear areas the officers were trying to do something about the problems but did not have the experience or the knowledge/understanding about how to go about it. There was very little, or no back-up from home, no one was recruiting, etc; no continued support was evident. For example, because of the need for men, the whole Regiment would be despatched and no-one was left behind in England in the Depots. The whole structure was wrong. The Esher Report (early parts of which were published in 1904) fully published before WW1 stated/argued that there should be decentralisation of responsibilities down to Districts. The Esher Report advocated that Districts ought to be permanent structures and should be responsible for supplying, provisioning and materiel support for themselves.

Keegan (1993:361) wrote: "By 1914 the age-old scourge of disease, always hitherto war's chief agent of death, had been lifted from armies; the Boer War (1899-1902) was the last in which the British army suffered more fatalities from sickness than from missiles."

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14.1.2 Data Sheet And Findings From Case Study M1:-

Goals/Objectives:

To sustain/support and back-up the British and Empire Armies in South Africa such that they had the required combat power and resources whilst they drove the Boers out, relieved the besieged towns and protected the British juridictions.

Strategies:

Use of steam-ships and railways. Special railway war cycle was designed/built.

Air balloons used for reconnaissance. Use of semaphore, heliographs, cyclist messengers and early field telephones for communications/information transmission.

Change of uniform colour. Keep men in touch with home via an extensive mail/postage service.

Characteristics:

Maximum scale war operation for the British: the largest British army sent overseas until that time, and each of the three stages of the war required different scale/level/type of support.

Long distances; train transport used for trunking/stemming and steam-ships for intercontinental.

Cross-country mobility was essential: mostly via horse - supply of horses was therefore crucial.

Disease was endemic (mainly typhoid) because of insanitary conditions within the British camps.

The Boers sustained themselves wherever possible with acquired British equipment/guns/supplies, etc.

Telegraph line repairs/extensions and pontoon constructions across rivers kept British Army engineers busy throughout the war.

Medical support was needed/required but its provision was not very well planned, or administered.

Proportion of headcount resources not managed very well; when all the soldiers in Britain were sent to South Africa, none were left in Britain to resource/staff the supply system.

Principles/Concepts:

Primarily a single chain of supplies from England to Cape Town, then divergent network throughout SA.

Links and nodes concept.

Communications for maintaining contact and conveying information on needs/requests.

Global supply of horses/mules.

Allocation of resources to best advantage: steam-engines and oxen were used for hauling wagons/supplies, thus leaving horses for combat/military purposes.

Columns were divided into smaller units to enhance mobility with some dependence on local resources.

Mobility and speed.

To reduce conspicuity, the British uniform colour was changed from the red-coat to khaki.

Outsourcing (contracting out to civilian enterprises) was employed, but the poor relationships meant the military was not very pleased or overwhelmed by the outcome results (and thus helped to prompt the Esher Report).

Starvation and restriction of the enemy to have access to support/sustainment.

Performance Indicators:

Number of horses needed versus the number obtained.

Supply handling capacity/rate and consumption/replenishment rates (tonne/day).

Losses - what, and how much was being stolen/taken/ambushed by the Boers.

Inventories/stocks on-hand.

The front-line(s) were never short/without.

Casualties - from both combat and disease/sickness.

Rate of construction of the blockhouses and linked fences.

Areas free of Boer attacks and areas where Boer activities could still be expected.

Coverage/sweep and Speed.

Teeth to tail ratio (fighting men to engineers/supply men).

Dimensions:

Scale, scope, area of continental mass and intensity of the operation/war.

Transport/fleet size and make-up/profile. Health and fitness of the soldiers/participants.

Distance/reach (km).

Time (hr).

Weight (tonne or kg).

Headcount and number of horses.

Inventory/stock amount (number off (It), weight (kg), cases (of food and ammunition) and/or volume).

Space: area (m^2); and cube (m^3). Cost (£) - after the event.

14.2 Visit To The British Army Of The Rhine (BAOR) - Germany - (Case Study - M2)

From Thursday, 6th July 1995 to Saturday, 8th July 1995 the visit to, and case study of BAOR took place. The visit/case study was divided into three parts:-
1) Sennelager: to clear-up any misunderstandings and/or administrative/security issues/matters; to give a brief explanation at an initial meeting of the purpose of the visit - a research case study - and the nature of the research; to finalise the programme of the visit/case study; and to meet/interview British Army soldiers and to start initial discussions on/about logistics.
2) Gütersloh: a meeting/interview with the Commander of 'Combat Service and Support Group - Germany' (CSSG(G)); a DROPS demonstration; a tour around the Regimental Headquarters of the 1st. Close Support Regiment, RLC; and discussions and interviews with various soldiers.
3) Herford: interviews, presentations/discussion meetings with: 1st. Armoured Division Officers - these were the customers of the Army logistics system; and various logistics army personnel of the Command Logistics Support Team of the 1st. Armoured Division.

SENNELAGER

At Sennelager I met many soldiers and I presented the purpose and nature of my research together with some of my preliminary work as illustrations/descriptions; I also mentioned the aspects/examples/variables that I was seeking as data. I also presented and explained my 'Types of Logistics' matrix model. This received a very warm reception and comments were made concerning the model which coincided with many of my own. Comments were offered, like in a War situation (quadrant one) all the four types of logistics were covered/supplied. Without exception they all said they recognised the different types of logistics, each type did exist and many of the audience offered stories and experiences that they had encountered, and which coincided with the model and they started to locate these into the matrix. The Falklands and the Gulf were mentioned many times, and some historical examples were cited too. - I felt good about this in general, and it really indicated the benefit gained from thorough preparation coupled with a reasonable understanding of the subject matter and peripherals. I felt people wanted to help and that they did not view this as a waste of time.

The point that came across most strongly was that commercial logistics was conducted for profit and that this drove the development and design of the system. For the military, reaction time - speed - time compression, availability and flexibility were key to the service they provided. An example was given regarding the Falklands campaign: that the swift response, flexible approach, soldier training and readiness, material and equipment availability and cooperation/relationships amongst the people involved in the logistics was what helped the supply chain to be successful. The measures they used were: time - how long it took to do, or deliver, something; weight; quantity; material availability; equipment availability (they then debated the different availability measures and more or less agreed on 'combat availability' which meant that 'every little thing' on the equipment need <u>not</u> necessarily work/function, but the equipment was relatively OK and would work in, or go into, combat); space; accuracy of supply compared to what was ordered; delivered to the right/proper address (or map reference). Interestingly, cost was not mentioned. The difference between 'supply' and 'support' was raised.

They explained to me that in most cases, a logistics 'recce team' (i.e. a preliminary survey team) would be sent out ahead of any fighting troops, to ascertain: the 'lay of the land'; terrain; condition(s); distances; adequate locations in terms of suitability, cover and/or camouflage/vulnerability; and size/area for depots, camps etc.; etc. From such 'recces' the logistics and supply system was planned and designed (nodes and links), making sure that it complied with "Army Logistics Doctrine". For each new situation/circumstance a logistics structure/system would be established, i.e. tailored, for

its purpose. During operation, as the situation changed, the logistics structure/infrastructure would be modified accordingly to achieve a more appropriate fit. When the job was done/finished, the logistics structure/infrastructure would be dismantled. Reports would be written, for posterity, to record the "what went wells, and the what went badlies?" with explanations, etc. Generally, these were then used as examples in subsequent staff training/education sessions.

For further/future training opportunities, the commandant at Sennelager was in discussions with the Polish government about using suitable forest/terrain sites in west Poland as training grounds/locations for the British Army.

GÜTERSLOH

At Gütersloh one of the key aspects that came to the fore from interviews/meetings was 'scale'. Whilst intensity levels were the normal quantity deciders, the 'scale of operation' to be supported - number of soldiers, number and types of equipment, distances involved, area(s) to be covered, frequency of supplies, speed of operations, etc. gave consumption and order of magnitude dimensions.

During the tour around the complex, (which was very tidy and clean), trucks were parked in disciplined tiers and there was nobody else around except my guide and myself. Sufficient space for vehicular movement/turning and a sensible traffic flow arrangement for safety and ease of congestion existed. (A DROPS demonstration could not be put on for me, but I was not disappointed because I had already seen it in operation at Abingdon.) I was taken to a very large piece of hydraulic equipment adjacent to the railway line; it was a side loading/off-loading container handling device which handled containers on/off the side of trains and lorries/trucks - multi-modal facilities and capabilities. I was told that, very often, this piece of equipment would 'stick' and engineers would need to be called out to give it attention. (I commented on the fact that, surely, a routine operation cycle of the equipment on some periodic basis should be carried out to obviate this 'stiction' problem. The reply I received was yes, but, there were too few soldiers now and with the mandatory contingent off on training, it meant that many of the routine 'cycle runs' and 'first-line maintenance' were not being done.) However, the comments regarding the container side loader/off-loader, when it did function, were very favourable, particularly with respect to speed - time reduction - and ease of operation.

I was shown the different trucks - sizes and varieties (tankers, 8 and 14 tonne carriers, DROPS, etc.) and mechanical handling equipment (MHE). Again reference to the lack of 'first-line maintenance' and adverse comments about some design features were made - the insufficient 'squaddie proofing'. Many bad/poor design issues were pointed out; in particular, the bad design of the catch and operating mechanism of the circular man-hole opening cover/lid in the centre of the roof of the truck cabs. As so many design aspects were commented upon, this appeared to be a call/cry for help, or at the very least a review, to ascertain if these aspects could be amended in future models, or subsequent purchases. My guide assured me that these comments had been passed-on to his superiors.

The next stage of the tour was the workshops and stores where women soldiers were evident. Again the tidiness and cleanliness was very apparent. Transferable Stores Containers (TSC) and Field Material Storage Vehicles (FMSV) (these are basically mobile supply nodes) were seen. I was quite surprised at the low 'activity level' - very few people were around. Material/work flow layout in the shops had been thought through and was evident from the workshop design/layout. After the tour, my conversations/interviews with stores people indicated that a reorder point (stock level trigger) system was prevalent in their stock replenishment. Equipment spare parts came from the UK, other consumables - like fresh food, etc. - were purchased locally in

Germany.

HERFORD

This commenced with meetings/discussions/interviews with the customers of Army logistics - Officers of the 1st. Armoured Division. Their needs were: availability of equipment, ammunition and supplies; speed, i.e. short lead-times of supplies and maintenance turnaround time, as well as support following close behind their advances (i.e. forward repair group (FRG)); accuracy in supplying what was requested/asked for; simplicity and speed (i.e. least time and ease) of first-line maintenance needs; deliveries to the correct place/map reference (e.g. distribution point (DP), exchange point (XP) and equipment collection point (ECP)) as these change frequently (i.e. mobile nodes).

The Command Logistics Support Team (which included women) explained how the front-lines were its customers and the job was basically to give them what they wanted as near to immediately as was possible. To do this, various logistics squadrons/teams were formed/grouped, viz:-

- Close Support Squadrons that are assigned to support the Armoured battles.
- Artillery Support Squadrons which work alongside the guns and missile systems.
- Operational Field Distribution and IT Systems.
- Field Catering Troops which normally include a mobile bakery.
- Bomb Disposal Teams.
- Repair and Maintenance - although this was not directly RLC but REME.
- Medical - again not directly RLC.
- Etc.
- After any excercises or practice/trial runs a "Post Excercise Report" (PXR) is written and compiled indicating the 'goods' and 'bads' of the logistics aspects that were encountered, or discovered, so that the 'learning' is not lost.

I explained my preliminary findings/outcomes from my desk research of comparing military and commercial logistics and revealed my types of logistics matrix model. Much discussion and debate was had regarding the topics, but the matrix model was accepted as a realistic breakdown of the kinds of logistics they faced and had to contend with in their everyday lives/work. Again the point was made that in a real war, all of the logistics types would be in operation together supporting all the different kinds of engagements/missions which make-up a war.

COMMENT

Throughout my visit and arrival at each new location I would be asked: "How did you get on with Brig./Col./Maj./Cpt. so-and so?" they all knew where I had come from and where I was going to. The soldiers all new each other and I had the feeling that they were well in contact with each other - my progress/journey/case study was being tracked and their good contact/communications system kept them briefed with up-dated information.

14.2.1 Data Sheet And Findings From Case Study M2:-

Goals/Objectives:

To maintain/sustain/support an active British Army force in Germany (BAOR) at the prescribed state of readiness/alertness with safety, supplied hygienic conditions and for training purposes.

Strategies:

Stock-pile and sufficiency of inventories/equipment.
Training within different environments/conditions, intensity levels and terrains.

Characteristics:

Readiness and alertness levels varied/changed, thus operational intensity and demand levels varied.
Large scale operation. Support of both men (i.e. hygiene facilitations, etc.) and equipment.
Manpower shortages prevented the full 1st. line maintenance support to be carried-out fully/properly.
Front-line(s) are the 'customers' and therefore they had sway/power.
Data capture was primarily manual.

Principles/Concepts:

Nodes (with specific purposes and some were 'mobile') and links.
Re-order point(s) used for most replacement of supplies/spares at depots.
Unique product identity/code - Nato Stock Number (NSN).
Containerisation and the associated handling equipment for multi-modal transfer/switching.
Both home nation support (i.e. equipment/materiel from UK) and local purchases (i.e. fresh food).
Communications for maintaining contact and conveying information on needs/requests.
Readiness and availability.
Mobility and speed - DROPS and flat-racks, container handling/transfer equipment, etc.
Good layouts for material and traffic flow as well as for safety.
Geographical postponement - 'dumping'.
Availability of both equipment and stocks/inventories. Post Excercise Report (PXR) to record matters.
Outsourcing of the moving/relocation of soldiers and their families (this was a very high cost factor).
Relationships - good/helpful and co-operative team spirit - everyone knew each other.

Performance Indicators:

The proportion of recommended frequency checks that are carried-out on equipment (1st. line support).
Delivered to the correct address/map reference.
Speed, time periods.
Teeth to tail ratio (fighting men to engineers/supply men) and training.
Supply handling capacity/rate and consumption/replenishment rates (tonne/day).
Quantity of inventories/stocks on-hand.
The front-line(s) on exercise were never short/without.
Availability.
Casualties - from both accidents and disease/sickness.
Coverage/sweep.
Operations Evaluation (OPEVAL) and training.

Dimensions:

Scale and intensity of the operation.
Fleet size and make-up/profile. Health and fitness of the soldiers/participants.
Headcount (number of soldiers).
Distance/reach (km).
Weight (kg and/or tonne) and capacity handled in time periods (tonne/day).
Amount/quantity of inventory (number off, volume, tonne, cases (of food and ammunition), etc.).
Age of inventory.
Time (hr) or a specific stated point in time (or delivery window).
Costs (£ or DM).
Space: Area (m^2); and Volume (m^3).

Observation: Women soldiers were seen at all venues throughout the visits.

14.3 Operation Crusade - (Case study - M3)

Introduction

In order to gather data, then to collate and analyse them with respect to a military logistics' case study scenario, the UK Army was approached and asked if such a case study (or exercise) would be allowed. Fortunately, the request was looked upon with favour, and granted. One suggested opportunity which was offered turned out to be an exercise on Salisbury Plain which the Army was planning called "Operation Crusade". Operation Crusade was a simulated war to enable training and practise of both front-line and support services to perform their functions in as near a real life war setting as possible. Without hesitation the opportunity was seized by the author and a case study conducted.

Methodology

A case study approach was chosen - the actual purpose of the exercise. The unit of analysis chosen was the logistics support operations of the Army mounted to sustain the front-line. Data collection was in four forms: direct observations; semi-structured interviews with principal personnel; and unstructured interviews plus questions to/discussions with soldiers within the operations. The direct observations and interviewing/questioning was carried out by a form of non-participative ethnography. The main data recording methods were note-taking and audio tape recording. All the forms of data gathering were conducive to allowing this descriptive write-up of the case study. Operation Crusade was a ten day exercise running from Sunday, 20th March 1994 to Tuesday, 29th March 1994. The case study was conducted over a two day period - Saturday, 26th and Sunday, 27th March 1994.

The Case Study

The author was asked to arrive for 08:30 hours on Saturday, 26th March 1994, at Abingdon Airfield (an ex-RAF base which was now in the ownership of the "Close Support Squadron" of the Army's Royal Logistic Corps (RLC)). [Abingdon Airfield was the 'home base' support for the UK's Army contingent within the United Nations' force in Bosnia.]

On arrival, after clearing through security and receiving safety briefings, the author was taken by Land Rover to an encampment at the north-west of the airfield. During this journey, the author was told by the combat attired driver, that from this time onwards 'war conditions' applied. Approaching the encampment on the one road which led to it, we were stopped by a 'road-block'. This road-block at the entrance to the encampment was set-up to prohibit unauthorised entry. The driver gave a password and explained the purpose of the passenger. One of the two road block soldiers ran into the close-by pitched tent (with a cluster of radio aerials behind it), and he could be seen radioing and communicating with somebody. He returned to the Land Rover and gave an OK gesture, the two soldiers then opened the barrier and we drove through. The encampment was a large cluster of tents with camouflage netting and screens covering them. All soldiers that could be seen were: carrying rifles (SA 80s); wearing combat kit including helmets; and wearing "webbing" (a body harness and back-pack with many pouches), the webbing enabled the soldiers to carry the mandatory kit which consisted of:-

a hooded ground sheet	nuclear/biological/chemical (NBC) suit
30 rounds of ammunition	respirator and associated tablets
shoe cleaning kit	hypodermic/gloves/spectacles
weapon cleaning kit	a complete change of clothes
cutlery	a spare combat uniform/suit
washing kit and a towel	

Some soldiers were also carrying rucksacks and small bags which contained articles

and necessities associated with their trade, duties, jobs, etc. The Land Rover driver gestured arrival, parked close to the Mess tent and on disembarking he covered the vehicle's greenhouse. All parked vehicles (including fork lift trucks) had their 'greenhouses' covered with a plastic weaved tarpaulin; this was to avoid easy detection by enemy aircraft as a result of light reflections from the windscreens or windows. All vehicles carried such a 'plastic tarpaulin sheet' and drivers applied the covering after parking, removing it prior to pulling away.

On entering the Mess tent, introductions were carried out and the purpose of the author's attendance explained in greater detail than was already known by the Squad. At this point a short walk to the Briefing Room (i.e. an adjacent tent) was suggested for an overview of Operation Crusade and the associated logistics support.

Scenario

The setting for the mock war was Salisbury Plain, which represented an inverted apex for the coming together of three countries. The western portion was the hostile offensive aggressor called Retsina; the central portion was a neutral country called Liebfraumilch; and the eastern portion was the defender called Pauillac. The offending and defending nations were separated by the neutral nation Liebfraumilch (the author had noticed how this scenario had resembled the Bosnian situation). Abingdon was the Divisional Support Area (DSA) for Pauillac, - see Figure 14.1. The purpose of the DSA (a stationary bulk storage depot) at Abingdon was to provide ammunition, spare parts, food and medical logistical support for the Pauillac front-line forces during their defensive campaign; to be a complete Combat Service Support Group (CSSG). For this Case Study the medical support was not investigated.

The Ammunition Supply

(Note: for this exercise - Operation Crusade - real ammunition was not used, simulated (or 'simmo') ammunition was used; this was representative size and weight substitute boxes/containers of stones which provided realistic handling simulations.)

The complete ammunition supply chain was as that shown in Figure 14.2. Bicester, the Base Ordnance Depot (BOD) was a principal War Maintenance Reserve (WMR) bulk storage depot and held vast stocks of ammunition (and other consumables) which would be called off - as required - by Abingdon, the Divisional Support Area (DSA), which was approximately 75 km from the Salisbury Plain front-line; this was in keeping with the Army's logistics doctrine that DSAs should be stationary bulk storage depots positioned circa 50-70 km from the battle zone. The DSA owned and controlled transport and part of its function was to collect the cargo from Bicester (BOD) and to deliver cargo to the Brigade Support Group (BSG). It was possible for the DSA to collect freight from the BOD and deliver it directly to the BSG. On the edge of Salisbury Plain was situated a Brigade Support Group (BSG), which was a mobile storage depot which called off ammunition from the Abingdon DSA and which held stock quantities as dictated by the front-line. The purposes of the BSG were to cross-load, break-down bulk into smaller quantities if requested (although they preferred not to), and to move location as dictated by the advancement (or retreat) of the front-line, keeping within Army doctrine and thus maintaining a distance of circa 12-20 km from the battle zone. Cross-loading was sometimes necessary as the deliveries to the BSG were achieved with DSA controlled and owned transport, whereas collections from the BSG were achieved with front-line owned and controlled transport. The BSG owned no transport and was not responsible for controlling it; the only equipment they owned were heavy-duty fork-lift trucks for mechanical handling. In reality, a real battle/war may have two, three or more BSGs which would be fed by the single DSA. However, in this exercise (a small battle for training purposes only), a requirement for more than one BSG was not needed.

The Layout of the Three Countries Involved

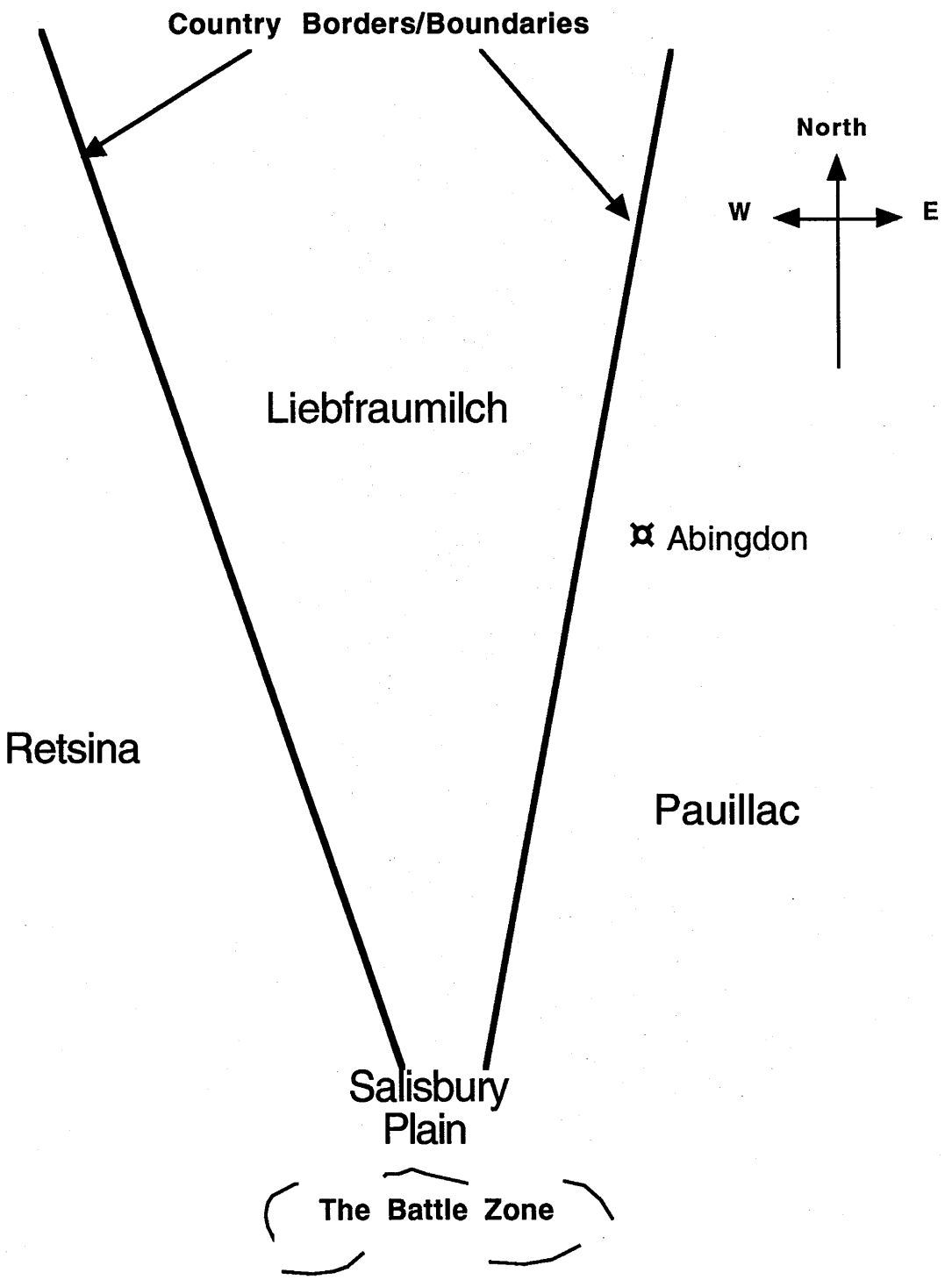

Figure 14.1 The Mock War Scenario

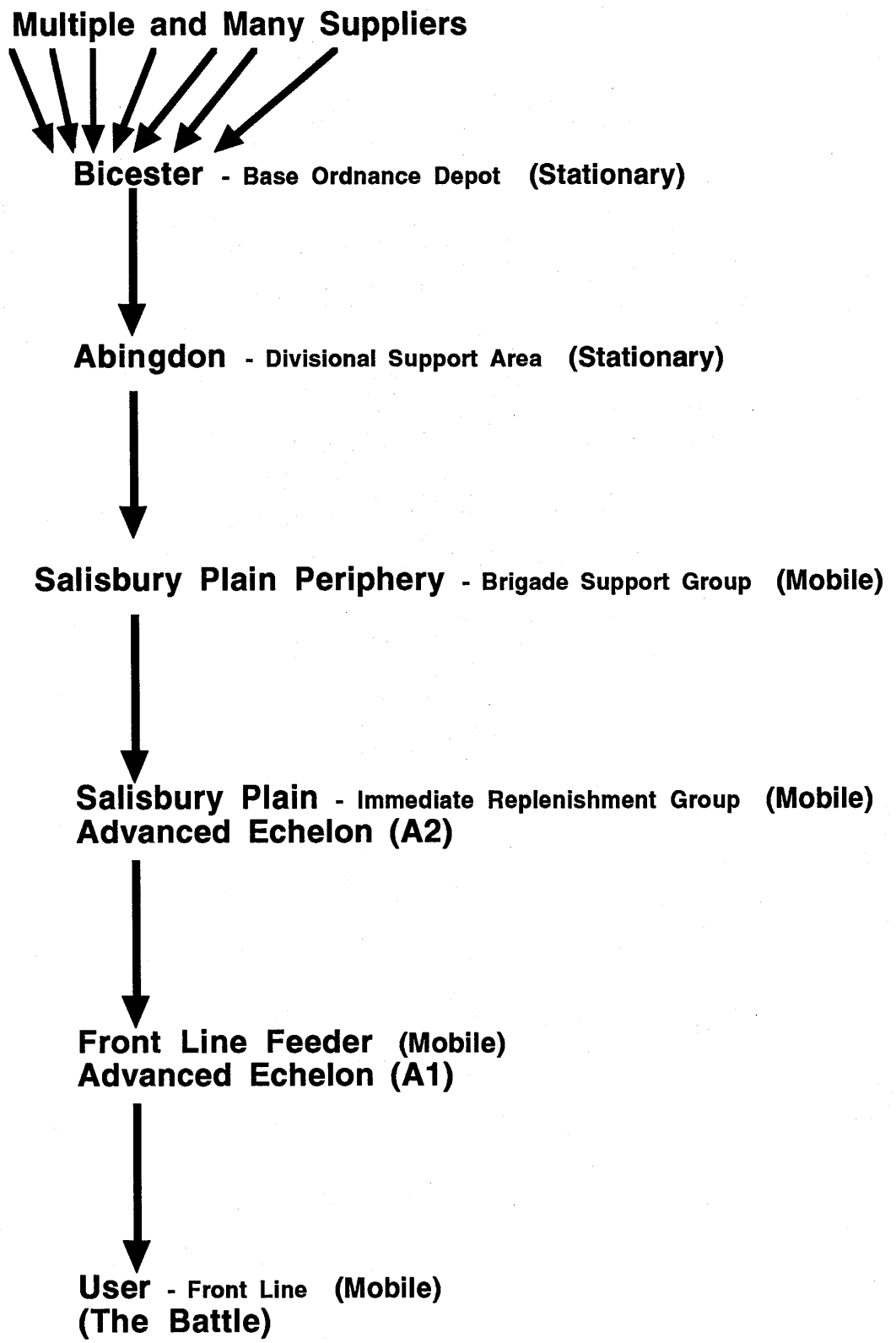

Figure 14.2 The Supply Chain of the Salisbury Plain Battle

The Advanced Rear Echelon (A2) or Immediate Replenishment Group (IRG) was a mobile store/depot whose function was to collect from the BSG, cross-load, break-down quantities again as necessary and to relocate position as the progress (or lack of progress) of the front-line dictated in order to maintain distances depicted within the doctrine. The Advanced Front Echelon (A1) would collect ammunition from the A2 Echelon and feed the front-line. Again, if necessary, the A1 Echelon could collect from the BSG and supply the front-line directly.

In the author's analysis the BSG was the main pivotal point separating bulk supplies and broken-down stocks (although the preference was not to break-down bulk), as well as being the divider of the transport ownership and control - upstream of the BSG owned by the DSA and downstream of the BSG owned by the front-line. Also, the BSG was the first mobile depot in the ammunition supply chain. All of the stages (or nodes) in the supply chain - with the exception of Bicester BOD - were open air storage locations.

Abingdon - The DSA

Following the briefing, a tour of the open air ammunition DSA site was conducted. The first evident aspect was the design of the traffic flow route. The whole site had a one-way traffic flow system. Traffic entered the airfield, progressed along the runway towards the north-west corner of the airfield, turned left into the encampment approach road, registered or checked-in at the security road-block, continued with another left turn to the control tent, where parking was available for vehicles whilst drivers obtained details of where to deposit loads if delivering and which loads to pick-up if collecting. The control tent was part of the encampment on a road which was parallel to the runway but with the traffic flow in the opposite direction. Continuation along the encampment road came to a multiple spur junction - four spurs in all - two on the left and two on the right, with the main road continuing ahead, where eventually a left turn was obligatory and which returned to the runway, and where crossing the runway lead to other parts of the RLC support operations, or where by taking a right turn proceeded out of the airfield - see Figure 14.3.

The one-way flow circuit ensured that all traffic passed through the road-block check-point (for enemy detection, security, etc.) and reduced the chance of accidents, particularly when travelling in a convoy. One interesting feature was that as war conditions were mandatory, all vehicles on the airfield (i.e. within the DSA) at night had to proceed without lights - black-out conditions applied. An aid for convoys travelling at night was a white disc about 20 cm diameter mounted on the rear axle/differential with a small light from above the disc shining on it. This could be seen clearly by a following driver, but could not be detected by enemy aircraft.

From the multiple junction the four spurs lead to separate storage zones; each zone was dedicated to specific products. There were three different calibres of ammunition, each with its own storage zone and a fourth zone dedicated to phosphorous. Phosphorous had to be stored separately and further away from anything else. Also, a water supply close by was mandatory for safety reasons in cases of emergencies (especially for phosphorous) - compliance with such stipulations/regulations was obligatory.

Deliveries or collections were carried out by first checking-in at the control tent, where a manual tabulated record of the movement of stocks was kept. (On four occasions during the two day Case Study the author witnessed a manual stock-take by a soldier visiting each of the four spur stores and tallying the tabulated record. No errors/discrepancies were evident on these four checks.) Subsequent to the checking-in, vehicles were driven to the appropriate spur store where deposits or pick-ups were made. All the 'simmo' ammunition within the DSA was transported by "DROPS" (De-

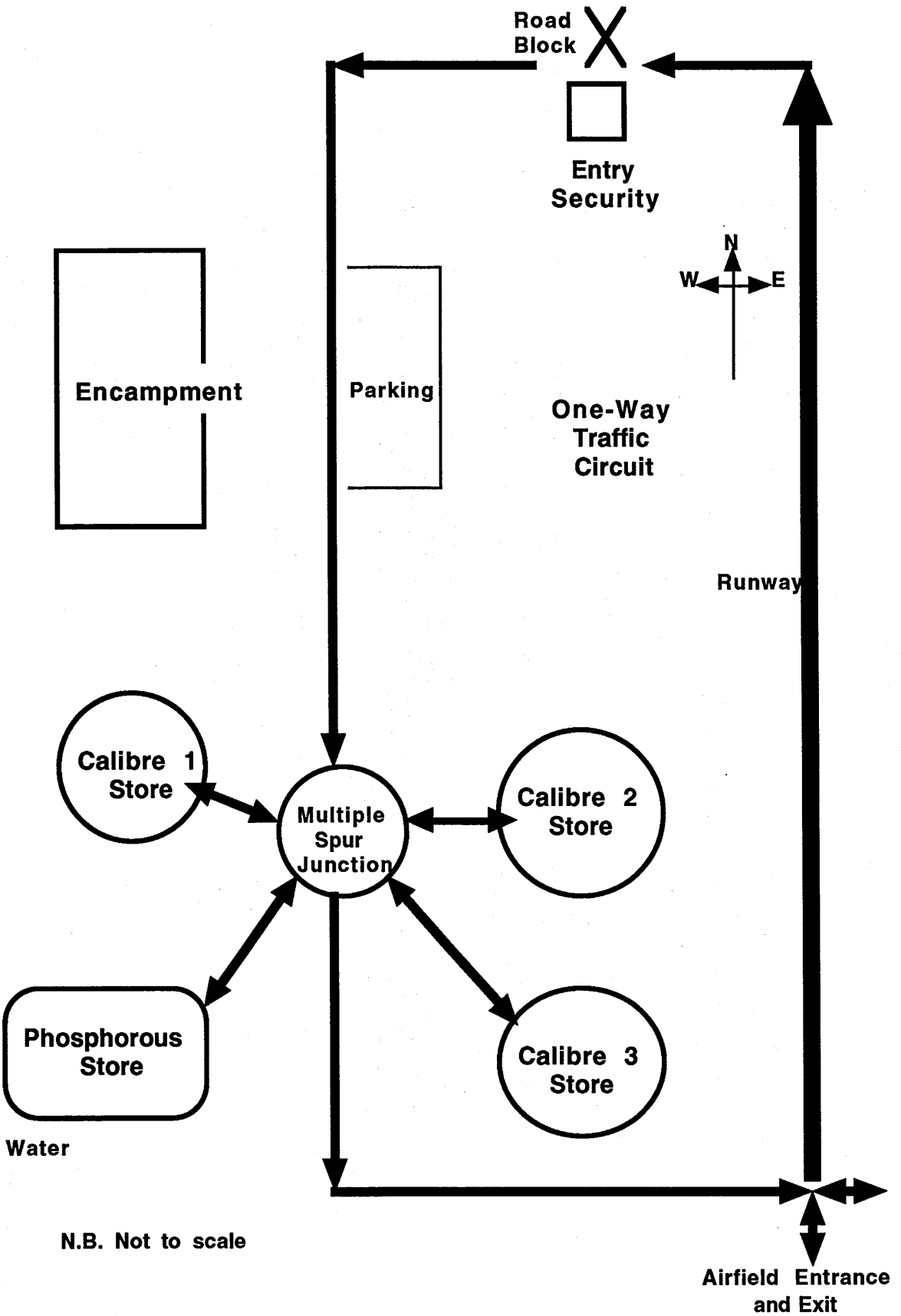

Figure 14.3 The Divisional Support Area Ammunition Layout

mountable Racking Off-loading and Pick-up System) lorries. The simmo was strapped to pallets and the pallets were strapped to the large flat racks which were picked-up or off-loaded by the DROPS lorries. DROPS was a very fast procedure and was custom designed/constructed for this military purpose.

Orders placed on the DSA for ammunition were received via two principal means from the IRG: "secure telephone" and "Tac Data Transmission" (TDT) - an encrypted Fax. Details given with the orders were: calibre (or type), quantity (by rack loads to obviate breaking-down bulk), a map reference for delivery and time required. These last two, map reference and time required were crucial as the IRG was a mobile store depot and itself tried to minimise the stock that it had to carry/transport every time it decamped and moved on; ideally it tried to carry nothing having issued all forward and receiving new stock at the new chosen location. Transport for the collection of the loaded racks and delivery to the IRG was organised from the DSA at Abingdon from its fleet.

Twice during the Case Study, the author saw a rack broken-down into two half racks of the two smallest calibre simmo. This was because of the imminent decampment of the BSG and assistance was being given to enable greater mobility on behalf of the BSG (generally the preference is not to break-down). One general observation was the fact that everybody knew each other and a genuine team spirit, common purpose, a positive spirit and willingness to help existed throughout.

The DSA replenished its stocks by placing orders on the BOD at Bicester, and then arranging transport for the pick-up. These orders were placed via "normal (i.e. unsecured) telephone". On one occasion during the weekend a consignment was arranged such that it was picked-up from Bicester and delivered direct to the IRG, i.e. by-passing the DSA at Abingdon. The main supply route (MSR) for the simmo was the A34 onto the A303 and then into Salisbury Plain as depicted by the map reference.

Time for lunch. Lunch was held in the Mess tent, sitting on wooden benches and using collapsible tables. The cooking facilities were ruggedised propane gas hobs and ovens with handles for portability. Flexible plumbing connected these cooking facilities to gas cylinder supplies. Aluminium plates were common place and these were usually personally owned by each soldier as well as his/her own cutlery. The design for mobility and portability was evident in all that was observed/noticed. The food was primarily 'composite' (colloquially known as 'compo'), which was vitamin rich and had some slight constipatory effects (possibly a good characteristic in battle/war scenarios!). The chef conveyed that to reduce this constipatory effect he tried to provide half compo and half fresh food. This was possible at the DSA but would be less possible at the BSG, the Echelons and beyond, although the principle was one that all military chefs attempted to pursue in times of conflict. The front-line and Echelon soldiers were probably receiving a 75/25 (compo rich) proportion rather than the ideal 50/50. The compo food came in tins/cans pre-packed in set menus for ten people. There were twelve set menus, which the chef said he mixed and matched within that as well, thereby increasing the choice, variety and offering a range of selections.

After lunch the author was driven to the south-east part of the airfield where another encampment was set-up. Again, prior to reaching the encampment a road-block was encountered with an out-post tented check-point, and security had to be cleared before being allowed entrance.

This part of the operation was the Squadron's Central Head Quarters and principal communication centre; many aerial masts were visible surrounding this complex. The first observation was that ISO containers were mounted on trucks and were kitted-out inside with work tops and desks; these were mobile offices. The trucks were parked forming a 'T' shape such that the back of the trucks - where the ISO containers had the

doors - formed the confluent part of the 'T'. This enabled a board walk reception area at the cross of the 'T' where access to any of the three offices was possible. Aluminium steps were placed at each door allowing the difference in height to be negotiated. The whole of this arrangement was covered by tentage which in turn was camouflaged outside.

A briefing was delivered on the communication linkage that was operating for placing orders in the campaign's logistical support. An illustration of the links described is given in Figure 14.4. The front-line through to the A2 Echelon (IRG) was via VHF radio which was clear (i.e. unscrambled). The link between the IRG and the BSG was again VHF clear radio, but used Tac Data Transmission (TDT) as well, as a back-up. The link between the BSG and the DSA had two media too, the TDT and secure telephone. Normal telephone was used for communications between the DSA and the BOD. The Head Quarters received much information about the general campaign and its role was to interpret whether any of the wider implications had any impact on the logistics. If this was so, HQ had to communicate as necessary and commence planning accordingly. (Some communications were recorded and would be analysed, used for examples in a "wash-up" to improve upon in the future and used for education purposes post the exercise.)

Leaving the Head Quarters, the author was taken to the north-east part of the airfield and after passing through another out-post security check-point, entry into a hangar and an office block was made possible.

This part of the operation was the mobile spare parts provisioning section and it supplied or obtained the parts (and unusual tools) for any repair work that was necessary during the campaign. Orders for parts (or tools) were received via secure telephone, TDT, or a soldier who came from one of the forward groups to pick-up the part(s). Knowledge of soldiers arriving was always known via telephone or radio communication links. If a soldier was not coming to pick-up parts then other transport arrangements were made. Two computer systems were displayed: COFFER (Computerised Office Enquiry and Request) which was in ruggedised casing for field use; and OLIVER (On-Line Inventory Enquiry and Request) which was office tied. All orders received generally came with the appropriate unique NATO Stock Number (NSN) (NATO Stock Number (NSN) is a unique thirteen digit number for every military part; the first two numbers signify the country of origin of the part, i.e. where it was made, the rest is part specific) of the part(s), as the engineers in the field had taken the NSN from repair manuals (either in bookform or computerised databanks). If no NSN was quoted then the experience of the unit's people came to the fore who worked at identifying it intelligently - contacting the forward groups if necessary until an NSN was obtained, or if a soldier from the forward group was present this assisted greatly in identifying the part and selecting the unique NSN.

The NSN having been keyed into COFFER, it displayed the current status (i.e. quantity and location) of that item within the mobile unit. If the part(s) were available within the unit, it/they were selected, thereby reducing the stock holding status and a duplicate print-out request form was obtained. One printed request form was then taken to a picker who then picked the part(s) and prepared it/them for onward transfer. The second printed form was sent/taken to Bicester BOD for replenishment of those parts. Parts received from Bicester would be credited into COFFER's records and placed in the right location (see next paragraph). Other items that were not held within the mobile unit were ordered immediately from Bicester BOD, or Donnington BOD whichever held the part that was needed.

In the hangar were nine ISO containers mounted onto trucks (which would normally be out in the open at a convenient point to supply the front-line in a real battle/war). Each

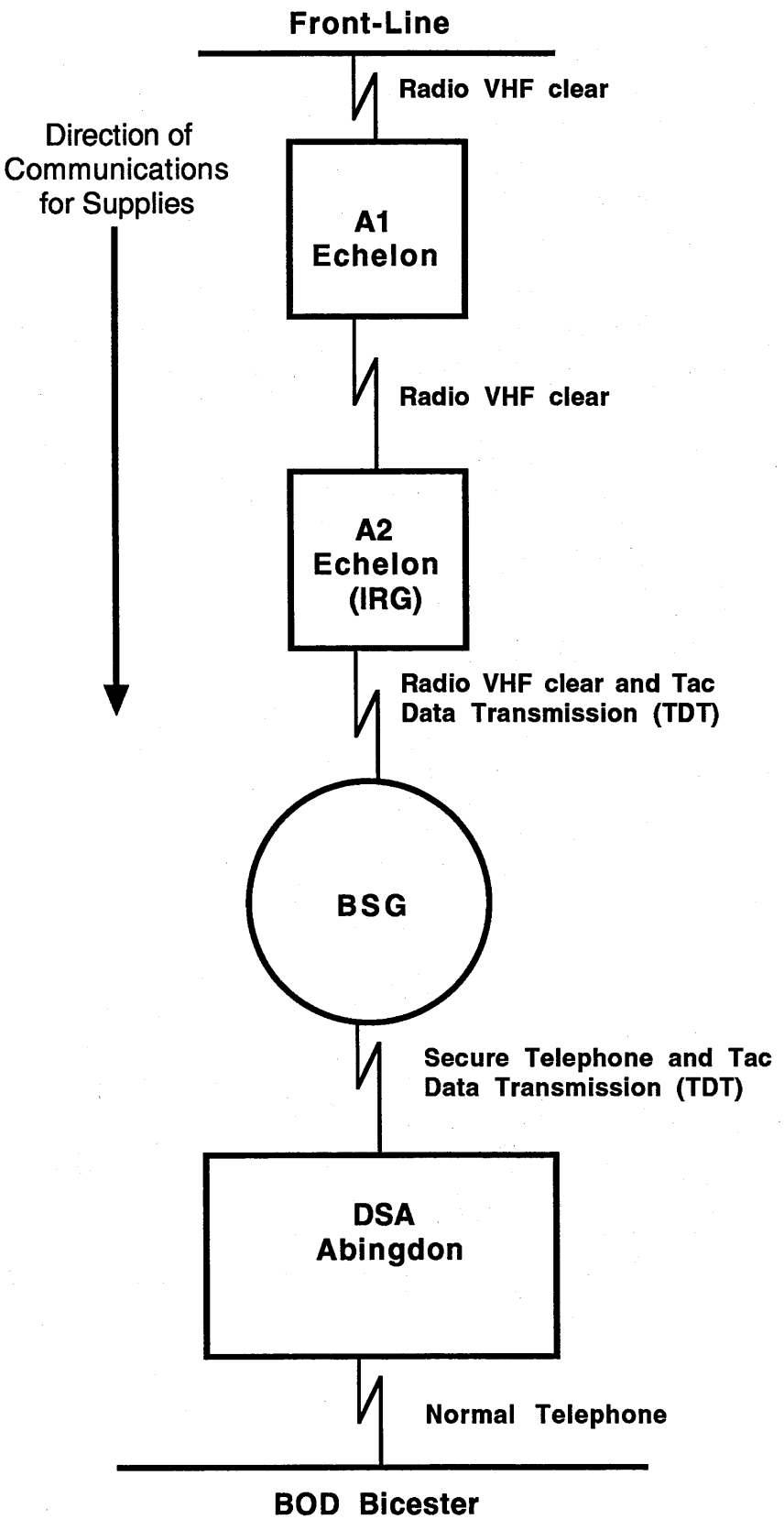

Figure 14.4 The Communications Link of the Supply Chain

truck/container unit was numbered - providing the location code given by COFFER. These containers mounted on vehicles (called Transferable Stores Containers (TSC)) had doors at the rear and were kitted-out with tiers of storage bins and cages. There were three tiers, one fixed on each side wall and a double sided movable central one which was set in/onto rails on the floor, which enabled it to slide from side to side allowing a small aisle for access on one side only at any one time. (An interesting feature of these container stores was the internal lighting, it only worked when the door was closed thereby avoiding detection by the enemy at night.) Each cage/bin had its contents' part name and NSN clearly labelled on its front, this aided quick locating and picking. The picker obtained all of the ordered parts on the print-out from the nine ISO container stores and consigned them for delivery or to await collection. There were also Field Material Storage Vehicles (FMSV).

The other computer system, OLIVER, was an on-line global inventory catalogue which permitted sight/visibility of all of the military stocks held by all the British, Commonwealth and NATO countries' locations. When parts were not available in this country, after inspection of this catalogue and finding the part available in stock anywhere in the world, procedures to acquire them were put into motion and the parts could be flown in. A weakness of OLIVER was the question of how reliable was the data? Because of batch updates, how recent had the catalogue been up-dated? However, it provided a global perspective and the principle and philosophy underpinning the idea were correct.

During the explanation of the provisioning procedure a picker provided a small fibre washer in a polythene bag with a NSN on it. He asked the author to take it to the ammunition control tent on his return to be given to a DROPS driver who was picking-up some simmo later that evening. At the end of this provisioning session the author took the fibre washer and carried out the request. Returning to the ammunition control tent was conducted in darkness, the whole airfield was in blackness; all outside activities including loading and unloading were carried out without lights. The white discs on the rear axle of trucks mentioned above were observed and they were very effective. At the ammunition control tent everybody was aware of the fibre washer part and who was collecting it. It was duly collected by the DROPS driver when he picked-up his consignment of simmo.

An evening meal was had in the ammunition Mess tent. A shift change-over of personnel was observed after dining; the author observed how similar this was to a shift change-over in industry. As supply was necessary continuously, shift changeovers were very much part of the normal routine. Also, a very evident aid to the smooth operations of all that was seen to this point was the fact that everybody knew each other and relationships were of long standing; true co-operation was happening. At this juncture the author was taken to a tent, given a water-proof sleeping bag and a camp bed, and very much needed sleep was soon in evidence.

On Sunday morning after breakfast in the Mess tent to the sound of pattering rain, the programme was to visit some of the forward mobile storage depots. The author was taken by car to the BSG on the periphery of Salisbury Plain; during the whole journey it rained.

Brigade Support Group (BSG)

The car pulled off the A338 into a lane which penetrated a wooded area; after about half a mile the car stopped and parked. The whole area was very muddy. In the distance about 100 m a small out-post tent could just be seen. On approach to this tent, a soldier appeared and asked for the password; all being in order access was given. About 50 m ahead was an encampment which consisted of three trucks with ISO containers mounted on them and parked in the same 'T' pattern and central board walk described earlier.

Obviously, the whole was covered by tentage and camouflaged. A parked JCB and fork-lift trucks had the greenhouses covered and all soldiers were in combat kit, helmeted and carrying their webbing plus accoutrements. The ISO container offices had maps, tabulated data and safety instruction leaflets covering the walls.

An explanation of the BSG's role was given; basically to order and receive bulk stocks of ammunition and fuel (diesel for trucks and tanks), to break-down the bulk and to have consignments ready for picking-up by the front-line at the requested times. Further roles were described. The previous evening in the battle a chemical/biological attack by the enemy was simulated by a helicopter dropping 2 500 litres of water on the Pauillac troops. Those badly wetted by the water were deemed dead and taken out of the battle, but the BSG had to simulate the digging of graves for the number assumed dead and had to go through the procedure of registering and certifying the dead. Naturally, those partly wetted were injured and were passed through the medical arrangements not covered by this Case Study. This BSG was in its third location during this campaign (i.e. it had moved twice) and the indications were that later that day it would be required to decamp, move and set-up operations again in another location.

Stepping out of the encampment and turning right into the woods, a clearing was evident after about 200 m. This clearing had three distinct clusters of simmo on pallets stored two high; each cluster was a different calibre ammunition. The ground was not flat and the elevated pallets looked extremely precarious, being both at an angle and not fully on top of the lower pallet. One reason offered for this less than perfect stacking was the fact that all handling at night was conducted without lighting. A fourth storage pile could be seen well out of the way - that was phosphorous. Fork-lift trucks were parked under some trees with greenhouses covered and concealed with tentage and camouflage. Apparently, up to this stage in the campaign, the BSG had handled 698 tons of simmo, averaging 100 tons per day.

The author was lead off further into the woods and after about 600 m fuel tanker trucks could be seen and again all greenhouses were covered. The BSG received 22 000 litre tankers from a Petrol, Oil and Lubricant (POL) DSA. These large tankers were down loaded into 12 000 litre tankers for the front-line to refill tanks (i.e. Challengers) and when required, into 25 litre 'gerry cans' for truck refuelling. Adjacent to one of the 12 000 litre tankers was a stillage full of 25 litre 'gerry cans'. Close to these parked tankers was a pitched tent where the soldiers dwelled. No actual activity was observed during the whole visit of the BSG.

Throughout the tour of the BSG, low flying helicopters were constantly flying close by, but to the south. The sound of low flying helicopters alone sounded quite frightening.

After this BSG visit, a short car journey to an area just off the A303 into a wooded area and then down a road which ended at a very large open space which was concrete screeded. This was the campaign's helicopter base and the Petrol, Oil and Lubricant (POL) BSG.

Petrol, Oil And Lubricant (POL) Brigade Support Group (BSG)

The familiar road-block and password ritual was contended with and access to the now familiar camouflaged encampment was granted. Across the road from the encampment were 3 parked helicopters, two still and the third with its rotor spinning. All the fuel tankers, both 22 000 and 12 000 litre varieties, had the greenhouses covered. The role of this BSG was to receive bulk helicopter fuel and diesel fuel for trucks, break down as necessary and have quantities ready for collection or use at this base. No activity was observed at this visit. However, it was evident that a small diesel spillage had occurred during the early morning and that great effort was being expended to clear

up the mess. Obviously, much of the conversation concerning the spillage was conducted out of the author's ear-shot, - it was very clear that an attempt to shield the author from the details of this incident was the policy. Again no activity was observed here.

Visit To An Immediate Replenishment Group (IRG) - Echelon A2

The author was taken to an IRG store, but again no activity was observed. A small encampment with a small stock pile of simmo and soldiers in combat kit.

Bicester (BOD)

This Base Ordnance Depot (BOD) employed 204 military staff and 1 317 civilian staff in a total area of 659 534 m^2. The total number of items held was 44 476 with an inventory value of £420 million. A typical monthly number of vouchers (i.e. number of items requested) handled was circa 108 000. There were rail (with sidings) and road links into the depot (and plenty of spacious landing sites should helicopters need to be used). ISO container handling equipment was available and multi-modal transportation was used often. During this exercise the computer system here 'crashed' and affected some supplies.

The Standard Priority System (SPS) was used with its range of 1 to 16 ranking. Prior to this priority system, they used to employ a colour coded system as follows:-
Red ** = 24 hours; Red * = 36 hours; Yellow = 48 hours; green = 4 days; and
Blue = 7 days. Predominantly, stock replenishment was via Re-Order Points. Bicester, like other MoD depots, had multiple and many suppliers. For instance, the MoD purchases wooden pallets from nine suppliers. (Author's thought: some scope must exist for a reduction and rationalisation in/of suppliers that would bring price reductions and cheaper transaction costs.)

An interesting feature about Bicester BOD was that when it was designed and constructed/built the distances between storage sheds, buildings, and storehouses were subjected to the Explosive Storage Regulations (ESRs) pertaining at the time - this covered for the event of air raids (as no ammo was actually stored here) - which meant that the storage sheds, buildings, and storehouses were far away from each other. In fact further away than was necessary because they were built with further expansion in mind - should the need arise for expansion subsequently, then no problem, or limitation, existed with the ESRs as sufficient space between the sheds/buildings was already available by design. Obviously, 'efficiency', with such large distances between sheds is not easy to achieve, or indeed possible. Whilst the MoD own the Bicester site/land, the previous owner(s) of it stipulated in the sale contract at the time that, should the MoD cease using the site/land, it must be restored/returned to its former use/purpose - an ornatmental garden/park/arboretum. So Bicester BOD can only be used as an MoD site, or as its original intended purpose/use.

Other Points

Women soldiers were prevalent throughout the Case Study and in most, if not all, of the locations/nodes. All contacts were helpful in the pursuit of the logistics Case Study, but when things were not quite normal, much was done to shield the author from such information. For instance, the oil spillage mentioned above. Likewise, it became evident that Bicester had a computer crash and some supplies were being impeded as a result; there were many adverse comments from soldiers about civilians who would not come to work on a Sunday to rectify the matter as this was only an exercise, whereas soldiers would have been obligated to fix the problem. (Comments were made to the effect that the civilian staff were very motivated, willing and cooperative during both the Falklands and Gulf campaigns - these having been real engagements.) During late Sunday afternoon a low flying air balloon came over the north west corner of the Abingdon airfield which caused a 'stir' because the soldiers were not sure if this was part of the

exercise or a genuine mishap by the civilian pilot? It appeared to be the latter. Also, a soldier had received crushed ribs at Abingdon by a DROPS lorry reversing and sandwiching the soldier between the rear of the lorry and a fully loaded simmo rack at/in the calibre 2 store. Another, incident was an unloaded DROPS lorry that had crashed into a ditch on the A303. Other than the simple information given here no other data was proffered on these accidents/incidents. A Post Excercise Report (PXR) would be written and compiled to record any lessons learnt, or issues that warrant attention. The Major who was in-charge of the Abingdon ammunition DSA site informed the author that he was off on a two week adventure training (AT) expedition on the following day at the end of this exercise (he was examining and testing with his appropriate AT kit/equipment). (Two months after this exercise the company of soldiers involved in this exercise was sent to Bosnia for a six month tour.)

Lessons Learned About Case Study Methodology

- An outline plan of the requirements from the Case Study helps pursue the right things, as many interesting distractions are available to cause a researcher to deviate.
- Generally, people are very helpful and interested in any research.
- Note-taking and recording by hand was long-winded, quite tiring and difficult - Sometimes interviewees or demonstrators had to be asked to slow down.
- Embarrassing incidents may be shielded from the researcher; this is not personal, it may be the policy of the organisation.
- A tape recorder - if permitted and acceptable - may have proved useful for some of the conversations.
- Photographs - if permitted and acceptable - may have proved helpful.
- A video-camera - if permitted and acceptable - may have proved helpful.

Subsequent Visits To Abingdon

Further visits to Abingdon were made on Tuesday, 24th May 1994 and Tuesday, 26th November 1996 which consisted of checking/validating the Case Study material, further interviews and some more detailed visits/observations of the facilities. The Logistics Regiments based at Abingdon, consisted of 1 200 officers and soldiers who form a vital part of the the home based 3rd. UK Division. They have served in Germany as part of the NATO forces. Some of the groups based/housed in/at Abingdon were:-

- The Brigade Close Support Squadrons assigned to support the Armoured Battle.
- The Artillery Support Squadrons whick work alongside the guns and missile systems.
- The Operational Field Distribution and IT system.
- The Field Catering Troops, which include mobile bakeries.
- The Bomb Disposal Teams.

Some of the facilities the author was shown and had demonstrations were:-

DROPS lorries/trucks.
8 and 14 tonne load carrying trucks.
Tanker (fuel bowsers) Fleet.
Ground laying fuel bladders.
Army Tank Transporters.
Transferable Stores Cotainers (TSC).
Field Material Storage Vehicles (FMSV).
A tracked BV 206 Oversnow vehicle: possesses a low ground pressure and can be used in some marsh and swamp areas. Used for infantry and mortar carrying as well as a logistics resupply vehicle.
A mobile heavy duty laundry (clothe washing and drying machines) unit with generating set.
Two different sizes of fork lift trucks.

In two of the very large hangars at Abingdon, the floors were being ripped-out and new floors being laid that would enable heavier loads to be stored upon them.

14.3.1 Data Sheet And Findings From Case Study M3:-

Goals/Objectives:

To keep the front-line sustained; to ensure that the front-line have the 'combat power' they request.
Bicester BOD: to hold, conserve, preserve and manage consumable War Maintenance Reserve (WMR) materiel/inventory/stocks/items for the whole British (National) Army.
To train all the personnel in the war time application of logistics (probably for a tour in Bosnia).

Strategies:

Simulated war conditions for: process ownership; training; and relationship development.
To follow/comply with logistics (and other military) doctine and safety/hygiene regulations/stipulations.

Characteristics:

Clear 'vision' and the purpose/objective was known to all.
Power was held by the front-line.
Volatility of demand - (and surges the author was told, although he never actually saw/experienced them).
Basically, a 'call-off' (pull) system was in operation.
Good verbal/radio/telephone/TDT communications (and the origin of the information source(s)).
Data capture was primarily manual.
Bicester BOD had both road and rail connections (i.e. rail track and sidings were on site).
Accidents occurred/happened.

Principles/Concepts:

Abingdon (the DSA) was what the Army called a Key Decision Point (KDP) - i.e. the beginning of a 'conduit' which fed the front-line(s). A Post Excercise Report (PXR) written to record matters.
All soldiers carried their complete kit/survival accoutrements. Food individually packed - minimise waste.
Good layouts for material and traffic flow as well as for safety.
For ammunition to minimise breaking-down and general handling. Use of Re-Order Points at Bicester.
Multiple/many suppliers/inputs and multiple/many links into Bicester (focal node) from up-stream.
Supply Chain - linear linkage from/out of Bicester (focal node) to down-stream.
Attempts to achieve supply smoothing, relationships and approach a JIT (pull) arrangement.
JIT principles were employed - minimum waste/excess (demand pull), forwarding according to 'call-offs'.
All nodes had specific function/purpose: mostly geographical postponement/proximity placement; for breaking-down bulk fuels from large tankers into jerry-cans as required; and to consign/consolidate.
Some nodes were 'mobile nodes' and they used Re-Order Points for spares replenishment.
Speed - DROPS and flat-racks, container handling/transfer equipment, etc.
Availability - both of equipment and stocks and visibility of stock holding at depot location(s).
Unique product identity via Nato Stock Number (NSN).
Priority system - fixed procedure/ranking at Bicester - Standard Priority System (SPS).
Relationships - good/helpful and co-operative team spirit - everyone knew each other.

Performance Indicators:

The front-line(s) were never short/without.
Quantity of stock (i.e. number off, or volume).
Delivery reliability: correct destination (e.g. map reference); on time/timely; speed; and with safety.
Shelf-life consumables issued on a FIFO ('first-in, first-out' - oldest issued first) basis.
Inventory accuracy and inventory condition (damage free and safe) - quality.
Availability.
Operations Evaluation (OPEVAL) - conducted post the exercise.
Coverage/sweep.

Dimensions:

Scale and intensity of the operation.
Fleet size and make-up/profile (e.g. trucks of 4, 8 and 14 tonnes capacity; fuel tankers of 22.5 and 12 kl).
Distance/reach (km). Cases (of food and ammunition).
Weight (kg and/or tonne) and capacity handled in time periods (tonne/day). Age of inventory.
Time (hr) or a specific stated point in time (or delivery window).
Space: Area (m^2); and Volume (m^3).
Headcount (number of soldiers). Health and fitness of the soldiers/participants.

Observations/notes: Cost (£) was never mentioned or brought-up although OLIVER did have a data column which indicated the value of the components/parts. Women soldiers were everywhere/throughout. An oil spill was treated with seriousness, i.e. an ecological/environmental concern was displayed/shown.

14.4 Thatcham Regional Depot - (Case Study - M4)

Introduction

As a result of the request to the UK Army to carry out Case Study research methodology data collection on some military logistics aspects, an opportunity arose whereby two Cases were offered. One was a military warehousing operation and the other a battle/war logistical support exercise (i.e. M3). Both were accepted and pursued. This monograph/vignette is the outcome of the Case Study research with respect to the military warehousing opportunity, a Regional Depot at Thatcham, near Newbury, Berkshire, conducted on Wednesday, 30th March 1994 and Wednesday, 15th June 1994.

Methodology

The Case Study methodology was employed to undertake the overview of (or the sectoral analysis of) the warehousing operations at Thatcham, Southern Region (Military) Depot. For the pursuit of data and information the principal modes of collection were: personal observations; semi-structured interviews; and questions to many personnel whilst having the features and aspects of the operation shown or demonstrated. Recording of the data and information was ostensibly via note-taking with subsequent review questioning to ensure that accuracy in the understanding was obtained. Two complete long days were spent at Thatcham carrying out the Case Study, these were Wednesdays, 30th March 1994 and 15th June 1994. The outcome of the Case Study was this descriptive monograph of the military warehousing operations and the Data Sheet which follows in section 14.4.1.

Thatcham Regional Depot

Thatcham, Southern Region (Military) Depot is a War Maintenance Reserve (WMR) depot/warehouse consisting of 91 685 m^2 sited near Newbury, Berkshire, employing two military staff and 228 civilian staff. The depot has five purposes:-

1) To store the full complement of the UK Army's Establishment (Establishment is a term used to represent the total authorised manpower numbers of the Army) equipment, accoutrements and vehicles (excluding tanks, cannon, etc.) for war and training/exercises for the Divisions based in the Southern Region of the UK.
2) To repair (or replace if necessary) any returned assets after use to ensure that the full Establishment accoutrements that are held/re-stored are in good usable order.
3) To store and maintain Adventure Training equipment for use by the whole of the UK's military (the whole MoD). Adventure Training equipment consisted of the full requirements for skiing, mountaineering, rock climbing, pot holing, abseiling, hang-gliding, parascending, scuba diving, etc.
4) To store the high value Regimental property/assets (e.g. silverware, etc.) of the Southern Region's Divisions.
5) To loan out vehicles to Brigades, Divisions, etc. when needed because of necessary repairs being conducted to their normal fleets, or to substitute for 'written-off' vehicles as a result of accidents, etc. pending permanent replacements.

The site at Thatcham consists of: many warehouses and storage buildings; repair shops covering many unique capabilities (an example of this is a special machine/process for the metallic re-edging of damaged snow skis); much open air parking for Land Rovers, trucks, vehicles, etc.; rail sidings and a railhead linking it to the main railway lines.

Procedures

The service or function performed by Thatcham Regional Depot begins as follows. A complete list of the Establishment for the UK's Southern Region Army Divisions are kept and updated accordingly when defence policies are reviewed. With this

information, Thatcham stores on an allocated basis for each Company, Squadron, Brigade and Division, the complete war stock accoutrements being in a ready state for deployment. A manual asset register for the complete complement is kept for each Unit and the actual possessed stock versus the Establishment stock is checked via a manual filing system. If a shortfall exists in a Unit's allocation, then an order for the unmatched items is raised for supply from Bicester, a Base Ordnance Depot. Bicester is one of the military depots that manages and carries out the purchasing function for assets and consumables for the UK Army. When Bicester supplies Thatcham with the ordered items they are credited into stock and stored with the Unit's allocated deployment stock. The filing system is amended accordingly to show that the original unmatched items are now held.

In the event of a Unit being deployed for war, or on a training exercise, it will issue a pro-forma request to Thatcham for the complement of accoutrements. The request is referenced and the accoutrements are consigned for delivery to the Unit at the destination asked for on the pro-forma. Should a Unit's allocation be incomplete, then a reassignment from another Unit's stock is carried out to fulfil the request with the appropriate recording, cross-referencing and reordering, if necessary, conducted via a manual filing system. Transportation of the consignment can be arranged by either the Unit or Thatcham and can be by road or rail. The pro-forma request usually stipulates who will organise the transport and which mode the Unit prefers. Contract transporters are not excluded and have been used quite extensively. The consignment is picked-up and duly delivered befittingly. This request process/procedure is modelled in Figure 14.5.

After use of the accoutrements, a Unit has to return the equipment to Thatcham with a completed corresponding referenced 'return note' detailing the content of the returned consignment with notation to any known missing items/kit. Thatcham receives the returned goods and performs two functions at the receiving bay. The first is to check returned items against the issuing consignment to ascertain if any discrepancies exist and the difference(s) noted. The second is to inspect the condition of the returned items and allocate them into one of three categories: good and can be returned to stock for reissuing; damaged and worth repairing so sent to an on-site repair shop appropriately and credited into stock on satisfactorily being repaired; and damaged not worth repairing, discarded and replacement orders raised for resupply from Bicester. This returned receiving activity is modelled in Figure 14.6.

With respect to the items that are not returned, the Unit has to provide a rationale, reason or explanation for the discrepancies. Accepted reasons are logged and the reordering for resupply from Bicester is put into action. Unacceptable or improbable reasons are adjudicated upon by an Army Committee and if condoned, then the reordering procedure commences; if not condoned, then the Unit has its budget debited to pay for the resupply, which Thatcham obviously handles.

So far no mention of value or cost for items has been mentioned. This is because no invoicing as such takes place, no money changes hands with regard to these normal missions. However, the cost of each item is recorded in the system for the purposes of public accounting, as all monies spent on WMRs are out of the public purse (i.e. from taxes), and such expenditure is answerable to (and has to be justified to) parliament. Also, for non-returned items without valid reasons, the amount to be debited to a Unit's budget is taken from this data.

Two exceptions exist with regard to invoicing, they are: the private hire of equipment (usually adventure training equipment) by military personnel, where a hire charge is made; and a handling charge is levied upon Regiments should they wish to have their silverware or other property withdrawn from storage for display or use at

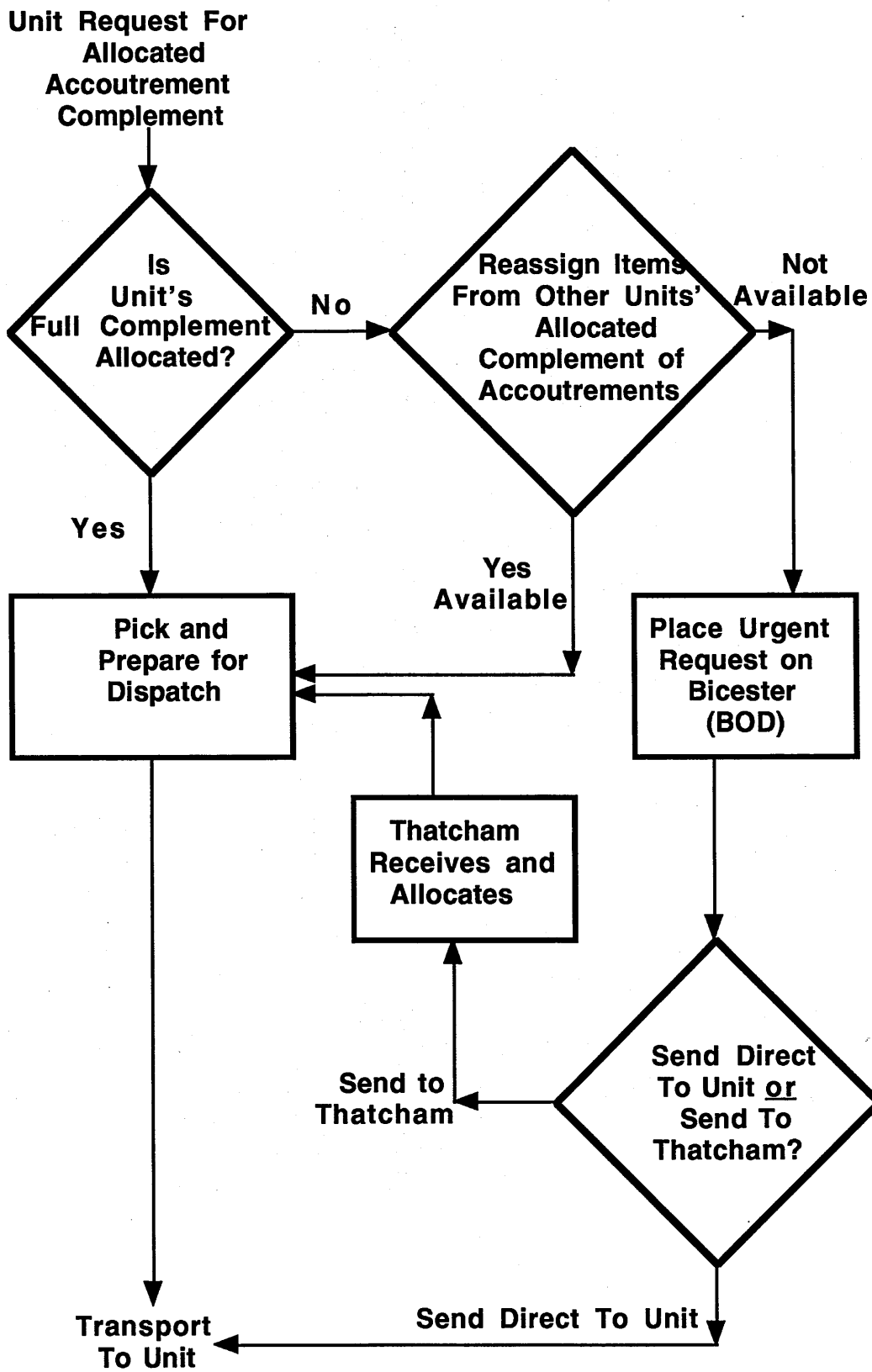

Figure 14.5 Thatcham's Procedure For Handling Requests

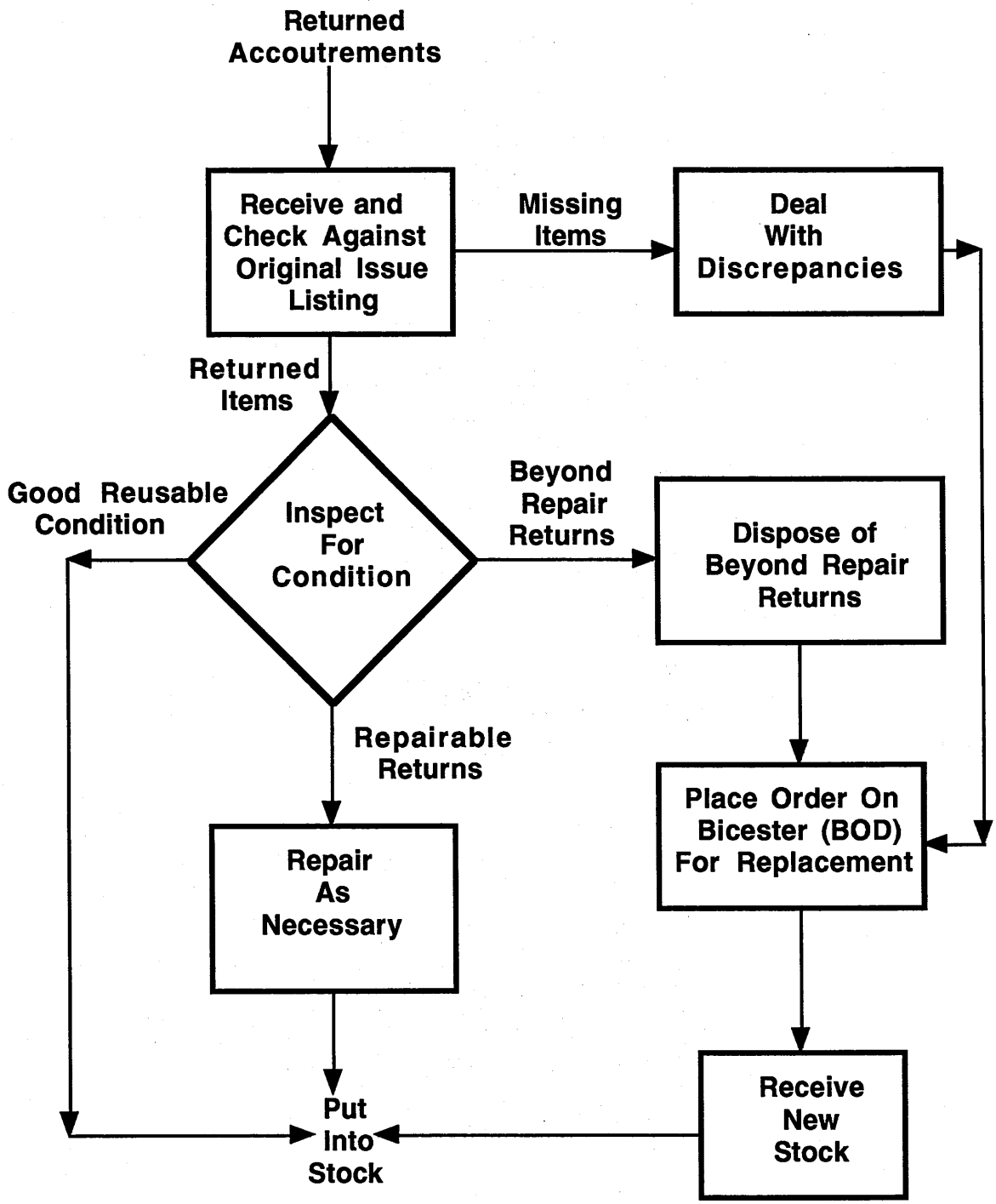

Figure 14.6 Thatcham's Procedure For Handling Returns

prestigious dinners, occasions, etc. The incidence of these two exceptions is quite small and a system for invoicing and collecting the appropriate fees does exist.

The structure for managing the above is achieved via groups of people (usually 3 to 5 in a group) who are responsible for set Units. The groups are responsible for the provisioning, up-keep and stocking of their set Units' complement. Two other groups also exist; they are for: the management of the Adventure Training facility and service; and the procurement of items from Bicester. All requests for new items are forwarded to the centralised procurement group, which is divided into four categories: adventure training, camping and tentage; webbing and all clothing other than adventure training; hardware facilities excluding vehicles; and vehicles plus their spares. The procurement group handle all interactions with Bicester, and occasionally with Donnington.

The groups work in a very large open plan office and are divided into areas by the use of well placed cabinets and cupboards which provides screening, some privacy and identifiable teams.

Computing has been introduced into Thatcham for the purposes of stock records and allocations, etc. However, a present computer introduction project, consisting of three phases, has only had the first stage implemented. The subsequent two stages have been deferred awaiting funding. The current installed computer facility is attached to the Adventure Training group only. The system has the conventional stock record, location and quantity, allocation, ordered and awaiting delivery, and expected date of return information status. It is a stand alone system and does not have a link from the office to the warehouse. Therefore, a fulfilled request raised on the computer by the group has an allocation made from a specific bin location and is debited from stock. A print-out is produced which is sent or taken to the warehouse where the items are picked manually and prepared for onward transmission.

Visits To Warehouses Or Storage Sheds

On site were many Land Rovers, various trucks and other vehicles parked tidily in-line. The whole site was very well kept in terms of tidiness and cleanliness. In the Adventure Training warehouse the colourful stock was stored in conventional wire net 'cage type' bins forming tiers of racks. The tiers and bins were coded for ease of locating. It was in this area that the author saw most activity outside of the offices whilst at Thatcham. Apparently, the sports gear (i.e. adventure training) has the most movement during peace time and seems to be the most popular of the jobs on site. Many people commented on the kudos (both justified and unjustified) attached to this entity.

Passing through many of the storage sheds, stocked items are kept in conventional wire net stillages which have fork-lift truck handlability. Stillages are stacked four high - that being the limit given the vertical space of the buildings. Each stillage is labelled with the content name, part number and quantity. All the visited buildings were very clean and tidy, but the items within the stillages were quite dusty. Much old equipment was noticeable, for example, hundreds (if not thousands) of galvanised steel buckets were observed and commented upon. The response received was that these have not moved for many, many years and were left over from World War One (WW1). It appears that 'no-body' is prepared to obsolete the buckets and dispose of them, so they remain stored at Thatcham. A variety of smells was evident (mostly musty, etc.), some peculiar to a specific warehouse. For example, the shed that held sand-bags was very pungent with sea water/salty aroma because these had recently been returned from Chichester after their use to control the flooding which occurred there during January - February 1994.

A privileged visit to the rifle shed was permitted. For security reasons, to gain entry to the rifle shed a prior telephone call had to be made stipulating the specific time of the visit (i.e. an appointment) and the names of those who would be visiting. On arrival at

the rifle shed, a door bell was used and the door was opened from inside admitting the visiting party into an ante-office. Here, a security visitors' book was signed and a visitor's tag was allocated to each party member. Passing through the ante-office the rifle shed was entered through another security door which was opened subsequent to the security procedure.

Rifles were kept in purpose designed fork-lift truck handlable plywood cases, stored four high. Each case contained 49 (SA 80) rifles, seven tiers of seven rifles in a tier. The tiers were separated by a pair of rectangular hollow carton cross members with seven equi-spaced scallops both on the top and bottom. A rifle sat in each top scallop perpendicularly to the cross member and the bottom scallops rested upon the tier of rifles below it. Thus the rifles were cushioned during transit and suffered no impact damage from each other. Also, the plywood cases were designed with easy removable sides enabling soldiers to pick a rifle quickly and move on, followed by a fellow soldier who would not be impeded in his pursuit to collect a weapon. Apparently, when deployed, rifle cases are lowered on the ground at the delivery place, the top and sides are removed and a line of soldiers pick a rifle and move away. The cheap cases were designed for this quick 'serve-yourself' distribution method and being made of an opaque material (and they were unmarked) prevented sight or knowledge of the cases' contents during transit, etc. Naturally, on leaving the rifle shed a reverse of the security procedure was experienced.

On making the inquiry, the author was told that a small amount of Royal Navy (RN) inventory was held here.

Comments

The author is very grateful for the opportunity of having had an Army operation to operationalise the Case Study research methodology. But, not having selected this Case Study "unit of analysis" himself (as it was offered by the Army), it is possible that a good site was given for the opportunity of the Case Study practice, i.e. a bias was introduced by virtue of the owner making the selection. Thatcham may have been a selected venue from many as it may be perceived by its owners as being a well managed/organised operation? In other words, a poor operation would not have been offered for fear of revealing the poor management/organisation, etc.

Other methods of recording data/information/conversations may have been appropriate, like tape recording, video recording, photographs, etc., assuming that these forms of data capture would have been permitted/allowed, given the nature and security aspects of the MoD.

A return visit was made for checking/validation, further clarifications, and interviews/tours.

14.4.1 Data Sheet and Findings from Case Study M4:-

Goals/Objectives:

To hold, conserve, preserve and manage allocated War Maintenance Reserve (WMR) inventory/stocks for the southern Region and to hold, conserve, preserve and manage pool equipment for the whole British (National) Army.

Strategies:

Consigned/allocated inventory holding.
Central Army/MoD 'adventure training' equipment store.
Central Army pool equipment storage/buffer.

Characteristics:

Many stock items were very old (circa 80 years old) purchased around WW1 time.
Road and rail connections (i.e. rail track and sidings were on site).
Equipment repair shops were on site.
Most administrative tasks were conducted manually - computer systems were being introduced (funding to complete these computer phases was being with-held, or was not available, at the case study time).
Adventure training equipment has the most movement (highest activity level) in peace-time; over 600 official Army 'expeditions' were conducted each year.

Principles/Concepts:

Inventory/surge 'buffer' covering both normal 'out-of-service' (OoS) equipment and operational shortages.
'One-stop-shopping' concept for the region it covered.
'Single point holding' (and therefore 'one-stop-shopping') for Army's 'adventure training' equipment.
Unique product identity via Nato Stock Number (NSN).
'Flat-pack' - ease and speed of assembly/dismantling/packing arrangements for many items.
Portability and handle-ability.
Use of Re-Order Points.
Contract/outsource (3rd. party) transport/haulage was/is commonplace.
Unmarked cases/containers that carry/contain guns (not to publicise contents).
Good layout(s) for flow of materials and traffic as well as for safety.
Relationships.

Performance Indicators:

National Audit Office (NAO) surveys/audits.
Stock quantity completeness of allocated Army Divisions' full complement, and conversely the shortfall.
Number of items ordered/handled/despatched per time.
Picking accuracy.
Packing security - damage protection and security.
On-time delivery - speed.
Safety.
Cost was an issue that was becoming prominent.
Speed - time issues, doing things faster.

Dimensions:

Headcount (number of staff).
Value (£) and quantity (number off) of stock/items.
Age of inventory.
Time (hr) or a specific stated point in time (or delivery window).
Space: area (m^2) and cube (m^3).
Weight (kg and/or tonne) and capacity handled in time periods (tonne/day).
Distance/reach (km).

14.5 Donnington Base Ordnance Depot (BOD) - (Case Study - M5)

Introduction

One complete long day was spent at Donnington BOD on Monday, 15th August 1994. Donnington BOD in Shropshire, covers an area of 525 777 m^2 where 1 388 civilian staff and 247 military staff are employed. The number of items held here were 264 927 with an inventory value of £1 509 million. A typical monthly number of vouchers (i.e. number of items requested) handled was circa 121 000. Its main purpose was to hold, preserve and conserve the Army's hardware, instruments and some consumables. The site was composed of parking areas, warehouses, one fully automatic warehouse, repair workshops, and offices.

After a briefing about security, meeting several people and receiving a presentation which allowed the collection of the above statistics, a tour of the site commenced.

Visit To A Consumables' Warehouse And Dispatch/Receiving Bay

Civilian and uniformed soldiers were in evidence throughout this warehouse. At the dispatch bay, overhead signs existed with the colour coded priority system clearly delineated, and indeed separate bays existed for, or were allocated to different priority status groups. As with all the other military depots visited (i.e. Bicester and Thatcham): the layout of the warehouse and packing/dispatch/receiving bays were well designed for the flow of materials; the racking and storage of material was tidy and adequate with sufficient aisle space for movements and accessibility; and the lorry/truck traffic flow arrangement was conducive to safety with a one-way system, security and space. (Apart from the fully automated warehouse visited later, this warehouse had the highest activity level.) From entering to leaving (a period of about 2 hours) the same packed/palleted consignment stood on the dispatch bay floor; obviously this had been prepared ready for picking-up ahead of time. An interesting fact that came to light was that the highest number of orders or requests received here was for AA size Manganese dry batteries (UM-3). Obviously, for these limited life item types, a FIFO system was in operation.

Stock replenishment was via Re-Order Points.

Visit To A Hardware Warehouse

Again, spacious and well designed layout for material flow was evident. It was noticeable that many of the instruments/gauges, etc. on the shelves and in the racks were old - purely by the technology of them. This was confirmed by the staff who commented that many of the items held had never moved for years (they were non-movers) and, in their opinion, the likelihood of them ever being requested was low.

The tank and cannon/gun barrel store was interesting. These were high value items and had a specified life-span (i.e. number of rounds fired). Therefore records had to be kept on any returns that had not been fully used. Also the number of these barrels that should be kept/stored was a difficult question to answer and an admission was made that nobody knew the answer. (The author's comment was that in industry an analysis of the past usage/requested rates would be carried out and extrapolations, coupled with any seasonality corrections/modifications, from this historical data would guide such decisions.) The equation/interaction of: the training/exercise rate of the Army and military; engagements in current policing roles and conflicts; and being prepared with the right availability of these barrels for any eventualities that might crop up; required a 'crystal-ball'. This was the first military operational encounter the author had where the issue regarding cost(s) was raised without it being solicited.

Some Royal Navy (RN) and RAF equipment was stored here and generally, there was a *3-point dispersal* storage policy in operation.

Fully Automated Warehouse

This computerised warehouse was the busiest area seen at Donnington. My guide mentioned that his biggest problem was cubic space usage (or more correctly wastage) - operators would use an empty storage pallet cage/container/stillage rather than retrieve a partially used/full one and add to it - how could he rectify this? The author advised him to *withdraw* a certain number of pallet cages/containers/stillages, i.e. take say, 20% of them out of circulation; he seemed pleased with the advice. A mixture of items were allocated in these pallet cages/containers/stillages; because of the 'smart' computerised recording arrangement there was no need to store like-with-like items together. The pallet cages/containers/stillages had unique barcoded identities and automatic guided vehicles (AGV) transported them to and from the warehouse's internal handling facilities that would take (or retrieve) the pallet cages/containers/stillages to (or from) storage locations which were recorded by the computer, and such information (i.e. item(s) and quantity, location, date that the pallet was last handled, etc.) could be retrieved/viewed on a terminal/screen. This warehouse made good use of vertical space, it was the tallest building on site.

Presentation To The Staff

I was asked to give a brief presentation of my work to some selected staff and following this, various discussions ensued:-

The relative merits of just-in-time (JIT) versus just-in-case (JIC).

The difference between supply and support.

The merits and demerits of various inventory holding policies.

The 'mind-set' of people and traditional practices versus new procedures/methods: how can change be effected?

In peace-time, given the known successes of past habits/practices: how can new systems and procedures be tested properly - i.e. under demanding/high duress cicumstances and situations?

The relationship between MoD and industry given that MoD needs/requires speed, accuracy, availability, and long credit periods versus industry which seeks profits.

The logistics type hypothetical matrix was received well and people stated that they recognised the component parts and the relevance in differentiating them - they could generally relate to it and it was accepted.

Interviews were then held.

14.5.1 Data Sheet And Findings From Case Study M5:-

Goals/Objectives:

To hold, conserve, preserve and manage War Maintenance Reserve (WMR) hardware inventory/stocks and equipment/kit for the whole British (National) Army.

Strategies:

To hold good condition inventory and quickly dispatch requested items/complements.

Characteristics:

Road and rail connections (i.e. rail track and sidings were on site).
Many stock items were very old (in some cases obsolete).
Difficulty in knowing/deciding the right quantities of stock items to hold/keep, e.g. the number off of types and quantities of tank gun barrels, etc.
Equipment repair shops were on site - preservation/conservation.
Requests/orders/demands come in via the three flow types: baseline; cyclical; and surges.
The highest number of requests/orders received were for AA batteries.
In the main, predominantly manual systems were in place with the exception of:-
Had one fully computerised automatic warehouse system with automatic guided vehicles (AGVs) and unique storage container/stillage/cage identification via barcoding.

Principles/Concepts:

Inventory/surge buffers.
One-stop shopping for the Units/Brigades/Divisions.
'Single point holding' for some of the Army's high value hardware equipment/kit/parts/components.
Unique product identity via Nato Stock Number (NSN).
Use of Re-Order Points.
Good layout(s) for flow of materials and traffic as well as for safety.
Contract/outsource (3rd. party) transport/haulage was/is commonplace.
Shelf-life consumables issued on a FIFO ('first-in, first-out' - oldest issued first) basis.
Relationships.

Performance Indicators:

National Audit Office (NAO) surveys/audits.
Number of items ordered/handled/despatched per time.
Picking accuracy.
On-time delivery - speed.
Cost was an issue that was becoming prominent.
Packing security - damage protection and security.
Speed - time issues, doing things faster.
Volume/cubic space utilisation.
Maintaining/keeping records/the traceability of 'life-limited' parts - e.g. tank gun-barrels

Dimensions:

Headcount (number of staff).
Value (£) and quantity (number off) of stock/items.
Age of inventory.
Time (hr) or a specific stated point in time (or delivery window).
Number of items held (It).
Weight (kg and/or tonne) and capacity handled in time periods (tonne/day).
Items/month (It/month).
Cost (£).
Space: area (m^2) and cube (m^3).

14.6 British Army's Logistics In Northern Ireland - (Case Study - M6)

Main contact: Logistics Support Base Commander, Lisburn Depot, Northern Ireland (1994-1996).

Introduction

As a visit to Northern Ireland to conduct the case study was not possible, the data had to be gathered via interviews and discussions with many army personnel that have served there. Also, some interesting/novel facts were obtained via other sources.

Case Study

The Royal Logistics Corps Unit's role in Lisburn, Northern Ireland (NI) is to move all troops and provide the military infrastructure to support and supply three groups: (i) the Royal Ulster Constabulary (RUC); (ii) the Army and; (iii) some tri-Service commitments. The tri-Service aspect is an economy and efficiency measure in that there is no need to have a separate Airforce and Navy supply depot in NI and incur a further two overhead, maintenance and upkeep costs, etc. The base handles: post/mail; supply; transport & movement; catering; and has fire appliances. The composition of the Base is: a troop movement squadron; two transport squadrons; a supply squadron; and a postal squadron. The Unit has a role (and attempts) to generate and/or help promote good community relationships. Soldiers do a 6 month roulement at the depot.

Supplies from Lisburn are delivered to other smaller Army depots in the Province; direct to the 'front-line'/end user and; to the Airforce and Navy drop points in the Province. The unit also picks-up supplies, from the seaport (and airport), which have been ferried-in and, collects items that have to be returned. (So the Unit has a pick-up and distribution role/function.) They can arrange, and quite often do arrange 'direct deliveries'. Transport of supplies into the depot are achieved by a combination of Army transport and third party transport; there is no bar on the use of non-military transport, in fact third party transport is widely used. The only exception to this is the transportation of munitions which is carried out solely by soldiers and Army trucks - this is never contracted out. Sometimes, when items are urgent and commercial quotes are unable to respond in the necessary time window, military methods and assets are used with all speed, like air-drops, helicopters, etc.

The supply of Land Rover spare parts are completely outsourced to Unipart. However, because this location/operation is seen as a 'flash/flare-point' and it is allocated a high "Force Unit Designation" and a high "Urgency of Need" the spare parts inventory is owned by MoD - to ensure their availability. Unipart's roles are to store, preserve and when ordered/requested to deliver the appropriate parts immediately.

The Lisburn depot holds among its inventories items like: ammunition and firearms; cougar radio sets; electronic counter-measure facilities; standard pack riot shields; the total 'mobility requirements' for each Battalion deployed in NI; items for each Unit as laid down on its Equipment Table; and the set inventory/stock and accoutrements for the 'Spearhead Group'. The depot has to manage, authorise and change the stocks/set packs, etc. as stated by the fighting regiments. The Spearhead Group is a standby Unit which is on immediate deployment orders and is stationed in England. It is used at a moments notice should circumstances, or the need arise. The soldier content of the Spearhead Group is changed every month as they are on alert call, they just have everything ready to enter into action immediately when the order is given. Should they be called into action then the inventory they need is in the province already. (I was told that such Spearhead inventory packs were kept in other potential 'flare-up' countries/areas/regions too.)

The depot also holds/carries other inventories to be able to respond to any 'surge capacity' that may/might be called for. In this regard, the items are things like Saxon

vehicles (armoured personnel carriers) and various portable equipment/instruments. Stock replenishments are achieved by a basic Re-Order Point system.

Relationships with, and knowledge of, the people involved in their work are major assets in the well running and efficiency of the operations. Although the ordering of replacement items and new orders (i.e. from Bicester) are conducted by the usual methods of: telephone; facsimile; post/mail; etc. (they do not have EDI), they do have a link via MODEM with Her Majesty's Stationery Office (HMSO). This link was at the request of HMSO, who supplied the custom software to allow the Unit to order direct. The use of this system enables the time from order placing to receiving the goods to be one day (and in many cases is less than 24 hours). Once the training has been done, the MODEM link/process is much easier and is cheaper overall; the Army and HMSO actually share the accrued savings between them.

The Unit is responsible for, and is measured by, 'outputs'. They have to use their systems, processes (they try to engender process ownership), operations, assets and resources to best effect. They are measured/judged by the Regiment's Executive Headquarters. It was explained to me that they have processes to perform; they use systems to enable them to function and the result is that operations are carried out successfully.

The priorities of the depot, and hence its behaviour, are set by the front-line who are the customers/end users. Basically, the depot has to 'jump' and respond to whatever the front-line want and need.

The Provisional Irish Republican Army (PIRA) have many 'live/active' albeit 'dormant' bands/cells/gangs with their own operational cache of arms/equipment. This is a logistics strategy of not 'keeping all your eggs in one basket' by having a widely dispersed operation. The organisation in general probably has a few concealed/hidden (i.e. some underground) principal or 'mother' munition dumps in Southern Ireland. One of the British government's strategies is (as far as it is able) to curtail/prevent/stem/stop the flow of arms/munitions/weapons to PIRA - to intercept, catch and confiscate these items on the inflow; and also, by persuading foreign suppliers not to conduct business with these trouble-makers. The problem becomes more abstruse/difficult to control and harder to gather meaningful intelligence about, with the advent of many 'splinter groups' that are emerging - on both sides, republican and loyalist.

14.6.1 Data Sheet And Findings From Case Study M6:-

Goals/Objectives:

To have the infrastructure to support: the Royal Ulster Constabulary (RUC); some tri-Service roles; as well as for the British Army. These include troop movement; transport; supplies; catering; postal; fire extinguishing units/services; and bomb disposal.
To deliver direct to the front-line end-user.
To match (and deliver) requested sustainment level.
To engender good community relations.

Strategies:

6 month roulement for soldiers.
Wide use of 3rd. party logistics/services (e.g. transport (excluding ammunition); Land Rover spares; etc.).
Good relationships with all parties involved.
Process ownership (e.g. Modem ordering system with HMSO and RLC with a 24 hour response time).

Characteristics:

There are surge demands/requirements (e.g. demands for Saxon vehicles and portable radios, etc.).
Unpredictable/uncertain environment and fast/rapid response needed.
All sorts of handling capabilities: ISO containers; hazardous materials; pallets; DROPS; post-sacks; etc.
Equipment repair shops/facilities on site.

Principles/Concepts:

Geographical postponement for: supplies; equipment (e.g. cougar radio sets and electronic counter measure facilities, etc.); and specific soldiers (i.e. Spearhead Group).
Assortment postponement (e.g. pre-packed counter-riot supplies/equipment; mobility requirements per battalion; and establishment/maintenance of Units' consignments as per Equipment Tables).
Use of the army Standard Priority System (SPS) and was allocated the 24 hour priority status Force Unit Designator (FUD).
Unique product identity via Nato Stock Number (NSN).
Nodes (with specific roles/functions) and links.
Relationships.

Performance Indicators:

Scenario matched staffing/resources/equipment.
Satisfied sustainment level. (Or what was not sustained/delivered?)
Establishment - soldiers/people and transport/vehicular fleet.
Output based. Operational capabilities - based on what can be done and what cannot be done?
Matched resources (Establishment) for the level of operation(s), i.e. under or over.
Training.
Operations Evaluation (OPEVAL).
National Audit Office (NAO) evaluations/audits.
Coverage/sweep.
Speed.

Dimensions:

Scale and intensity of the operation.
Fleet size and make-up/profile.
Headcount - totally military (number of heads/people).
Health and fitness of the soldiers/participants.
Time (hr) or a specific stated point in time (or delivery window).
Distance/reach (km).
Weight (kg and/or tonne) and capacity handled in time period (tonne/day).
Cases (of food and ammunition).
Cost (£).
Space: area (m^2) and cube (m^3).

14.7 Army Logistics Focus And Delphi Groups - (Unit - M7)

Introduction

This was a whole day Focus and Delphi Groups discussion/exchange held at Tidworth, Hampshire on Friday, 13th December 1996, with participants from UK Land (i.e. the fighting front-line; the customer(s)), Royal Electrical and Mechanical Engineers (REME) and the full range of RLC (ranks ranging from Lieutenant Colonel to Major General), including senior civilian personnel from MoD headquarters, Bicester and Thatcham Depots. (16 personnel for the Focus Group and 4 for the Delphi Group.)

Points Of Interest That Emerged

An interesting finding was that during peacetime, a very large proportion of the Army's logistics budget is used-up by moving soldiers and their families to new (including world-wide) postings. To retain a disciplined and motivated army in the field means that due attention has to be paid to the upkeep of the soldiers: sufficient good quality food; readily available laundry/clean clothing; proper facilities for personal hygiene and sanitation; suitable resting/mess and sleeping arrangements; and adequate medical advice and provision for health. It was recognised that diseases and combat wounds/injuries required prompt and urgent attention - and a policy of prevention rather than cure was pursued by the Army. The Gulf War was quoted as an example of how significant attention was given to these matters. It was envisaged that this policy would be continued for the future. In fact many of the participants referred to the adage, that because of the high capital intensity (i.e. expensive equipment) of the Royal Navy (RN) and RAF a large part of their roles was to sustain and support equipment, but a large part of the Army's role was to sustain and support the *man/woman*. Now, with the advent of women being a part of *every* army activity, their proper sustainment caused a significant rise in the number of inventory items held/being part of the active category and hence a rise in total inventory being held.

A 'triangle' was mooted/put forward to represent the role of logistics: it encompassed inventory; movements; and repairs. The question was raised about what is the difference between 'supply' and 'support'? (The author clarified this by stating: "Supply is purely to do with material flow in response to an order/request be it consumable or durable, and when it had reached its destination 'the supply' was finished until another order. 'Support' is the case when resources other than material is needed as well, or instead. For example, the maintenance of a helicopter may require a spare part - its acquisition and delivery is supply, but to fit the spare part on the helicopter takes another resource, i.e. a qualified fitter, mechanic or soldier - that is 'support'.") A nice comparison that was offered, suggested that military logistics delivered 'combat power' to the front-line(s) and this was analogous to commercial logistics which 'added value'. It was accepted that the front-line(s) possessed 'power' over the logistics behaviour. All were comfortable with a term used which was 'Total Logistics Concept' (TLC) meaning that the whole length of the umbilical cord needed to be managed in harmony/unison, which is equivalent to the 'Supply Chain Management' concept in businesses. A necessary component in this TLC was *'interface management'* which encompassed relationships and contact.

The delegates recognised that, possibly in the near future, the MoD would centralise logistics to supply/support all three Services. Should this be the case, most participants predicted that the supply/support for our forces - in any involvement or engagement, with or without Allies - would come from the 'Home Base'. That is a three part structure consisting of the 'Supply Base' feeding into a converging network or *funnel*, then along a *conduit* which might consist of many nodes/echelons, and entering a *diffuse* divergent distribution system or network to the place(s) of use/need. For flow control and allocation, at the beginning and end of the conduit would be *key decision points* (KDP). The 'Purple Joint HeadQuarters' (PJHQ) would be based at the upstream KDP, and the 'Joint Forces HeadQuarters' (JFHQ) would be based at the downstream KDP. (In the

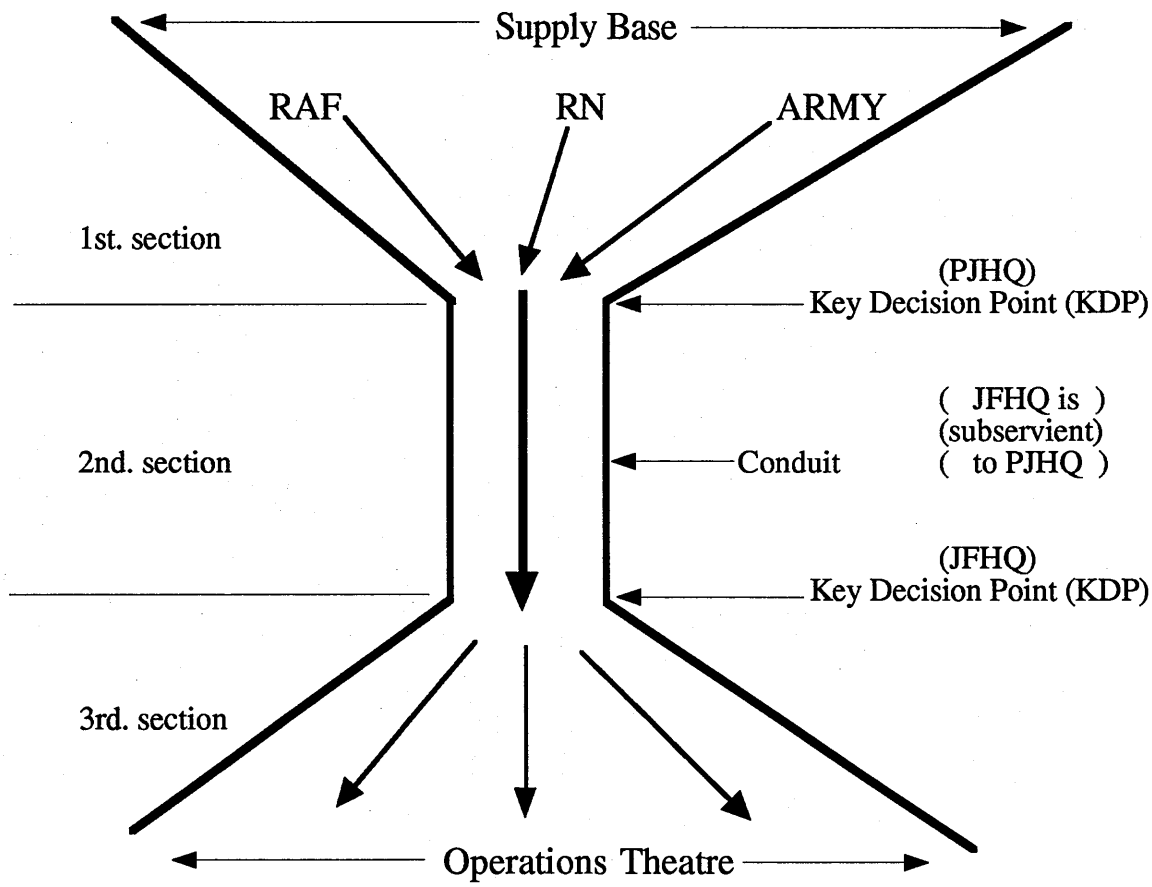

Figure 14.7 Possible Home Base Tri-Service Supply System

fighting arm command and control terms, the JFHQ is subservient to PJHQ.) The whole arrangement would operate a 'pull' (demand led) call-off procedure; see Figure 14.7.

The work/study that the Army was doing to establish if all its vehicles and power engines, etc. could be run by one type of fuel (liquid hydrocarbon) was referred to with the comment being made that this kind of standardisation would simplify matters a great deal - reduction of the variety problem, less mistakes, standardised/single couplings, etc.

All patterns/types of demand were a feature and formed the nature of what they had to contend with; and they knew that for them "War equals Christmas!" (although this expression was used to demonstrate the surge aspect, it belies the fact that this is a fixed date for commerce, the military surges are not so predictable). It was at this stage that I shared with them the logistics types hypothetical matrix and explained the four quadrants. The reception/reaction was one of acceptance with many comments supporting its validity. Surge management was deemed an area worthy of research for the Army.

I then presented the key features of this research and sought confirmation from the group where aspects were approved and others that needed/required re-visiting. Throughout the day, some words that were used many times in the exchanges were selected and the author showed how he thought businesses would deal with them:-

Planning)
Resources } These needed the application of 'Business Management Principles'.
Balancing)

Functions Processes	)	These call-out for the the aplication of 'Organisation Theory'.
Authority Responsibility Accountability	)	'Change Management' (culture change) practices required.

The issue about using industry and outsourcing some of the Army's (or some of MoD's military) logistics functions was raised. The delegates were keen concerning this and in their opinion, so was the MoD. They were keen to impart to me the current status/position. First of all, the RLC is an international organisation; it operates out of 15 countries with a staff of circa 30 000 people and has an annual budget of £400 million. Two executive agencies have been set-up in the MoD to manage logistics and supply chain requirements for its armed forces and these are encouraged to use private sector contractors. The first agency is the Army Base Storage & Distribution Agency (ABSDA), which controls storage and defines the Army's distribution requirements. The second is the Defence Transport & Movements Executive (DTMX), which is responsible for providing multi-modal transport and movement services for the world-wide support of the armed forces. DTMX also provides similar services for MoD, including supply chain logistics on behalf of the MoD Procurement Executive (PE), and it will support other government Departments and government sponsored organisations. In addition, DTMX provides removals and unaccompanied baggage services for MoD personnel, civilian and military, world-wide and to army personnel in the UK. It has access to contracted and in-house road transport in the UK and continental Europe.

Sea transport is available from sub-contractors and from in-house MoD resources, such as logistics support ships and landing craft. Rail transport is available through the terminal at Bicester to destinations in the UK and, via the Channel Tunnel, into Europe. The RAF provides/supplies air transport. Outside contractors are appointed and managed by the RLC - since the abolition of the Government Freight Agent (GFA), which acted as a link between the military and commercial sectors. Now, the RLC writes its own statements of requirement and contract agreements, and deals directly with its contractors.

They felt this arrangement gave them a better handle on what is going on and kept them in touch with industry. They gained from the cross fertilisation of ideas and experience from their civilian counterparts in the commercial sector - indeed a large part of the RLC's work was already in the hands of commercial hauliers. The task they had was to ensure that their contractors were managed properly and that the best service, reliability, quality and flexibility were being provided and maintained. "Flexibility and the capability to meet the Army's requirements is essential for the selection of a company to tender." Having mentioned selection, I asked them, how did they select contractors?

The selection process is rigorous; a pre-qualification exercise determines the job and type of of suitable contractors to meet the parameters. Potential tenderers are pre-briefed and then bid documents go to selected contractors. Returned bids are evaluated on the basis of price and the tenderer's capabilities in management skills, track record, equipment and facilities he uses/possesses. A short-list is drawn-up using a matrix of price and capabilities and a value points system. RLC staff visit the short-listed companies to check them and see proof of their capabilities, commitment and reliability. The winner is then chosen and awarded the contract.

The delegates/participants were thanked for their time and contribution and the sessions closed. Some individual interviews and discussions were then held.

14.7.1 Focus Group Main Questions And Delphi Group/Panel

An explanation of the purpose of the Focus Group was given to the assembled participants and the central theme/topic/subject matter in hand introduced with a brief description of the research being conducted, etc.

Tell me/what are some interesting anecdotes regarding any aspect of military (Army) logistics from your experience or 'tickles' you for any reason?

What achievements have been made in military (Army) logistics over the past 20 years?

What does military (Army) logistics have to do, what is its role/function?

Has the status of logistics/logisticians changed over the years? If so, how?

What has been the barriers to more/greater achievements in your logistics?

Do these barriers still exist? Are there any new barriers now? If so what?

What are the most difficult logistics things/aspects to achieve and why?

What would help you to make the above simpler?

What are the factors today that are the stimuli for any/further changes in logistics?

What do you think can be transferred from business logistics to military logistics?

What do you think can be transferred from military logistics to business logistics?

What do you think cannot be transferred from business logistics to the military?

If you were God - i.e. nothing in your way - what would you change/do to improve the logistics?

Where should logistics be and what should it do for the future? What are the new demands that will be placed on logistics in the coming near future?

What logistics research would you welcome, or would you suggest should be undertaken?

Is there anything you would like to tell me, or share with me about logistics?

The Delphi Group/Panel (which consisted of two Brigadiers and two Major Generals - all very experienced senior army logisticians) was more of a 'validation' board for the work I had conducted to date and for confirmation/validation of my ideas and models. It also ensured that the right tack was being pursued with the correct foundation(s). Basically, to check that the research end outcomes were reasonable aims and targetable (in essence a 'reliability' check).

14.7.2 Data Sheet And Findings From The Focus And Delphi Groups - M7:-

Goals/Objectives:

To provide a cost-effective army logistics supply/support facility/back-up for both people and equipment.
To explore the introduction of commercial/business logistics practices where appropriate and applicable.

Strategies:

Training/education of officers/staff/soldiers - the establishment of procedures by logistics professionals.
Exchange of knowledge and understanding of the commercial/business principles, procedures, practices.
Delivering 'combat power' was seen as the commercial equivalent (an analogy) of 'adding value'.
Employing a Total Logistics Concept (TLC). Standardisation (i.e. fuel example).

Characteristics:

The power lies with the 'front-line' and understanding what they want/need is crucial.
Surges, cyclical and all other demand profiles are possible. (War = Christmas)
The heterogeneity of items/products handled/transported - and soldiers/people too.
A 'triangle' of: inventory, repair, and movement, was seen as central to the function/process.
Women soldiers are part of *every* army activity, both peace and friction; sustainment of people's hygiene.
Ingrained/embedded culture may be an issue/problem.

Principles/Concepts:

'Nodes' with specific purposes and 'Links'.
Unique product/item identity via Nato Stock Number (NSN).
Converging and diverging logistics networks; supply chains; expedition logistics; and specials. Whatever is needed/required would be instigated/employed.
'Interface management' was recognised as being important - which encompassed relationships.
Key decision points (KDPs) - and their location - within logistics networks/chains was seen as important.
'Pull' material concept approach.
'Standardisation' wherever possible.
Change management (culture change) was seen as inevitable for the placing of, and defining: authority; responsibility; and accountability.
Organisation theory was seen as important for: function(s) and processes.
Business management principles were needed to effect: planning; resourcing; and balancing.

Performance Indicators:

The front-line should never be short/without therefore, scenario matched staffing/resources/equipment.
Satisfied sustainment level. (Or what was not sustained/delivered?) Training.
Establishment - soldiers/people and transport/vehicular fleet.
Output based. Operational capabilities - based on what can be done and what cannot be done?
Matched resources (Establishment) for the level of operation(s), i.e. under or over.
Quantity of stock (i.e. number off, or volume).
Delivery reliability: correct destination (e.g. map reference); on time/timely; speed; and with safety.
Operations Evaluation (OPEVAL).
Shelf-life consumables issued on a FIFO ('first-in, first-out' - oldest issued first) basis.
Inventory/stock accuracy and inventory condition (damage free and safe) - quality.
Coverage/sweep.
National Audit Office (NAO) evaluations/audits.

Dimensions:

Scale and intensity of operation (consumption and devourment rate).
Fleet size and make-up/profile.
Headcount (number of people). Health and fitness of the soldiers/participants.
Weight (kg and/or tonne), cases (of ammunition and food) and capacity handled in time period (tonne/day).
Distance/reach (km).
Time (hr). Cost (£).
Items (It), number off of items, and number of items handled/ordered/consumed per time (It/day).
Space: area (m^2); and cube (m^3).

14.8 Expedition Logistics - (Case Study - E1)

The main purposes of expeditions are DISCOVERY, EXPLORATION and CURIOSITY - however, there are occassions when other motives intervene: Nationalism; Headlines/Glory; Adventure/Sport; Virility; and Greed. The Royal Geographical Society (RGS), in common with other sponsoring bodies, requires to be convinced and satisfied that three aspects of an expedition/exploration have been thoroughly thought out before advancing monies/grants/sponsorships in support of any expedition. The three aspects are: (i) the purpose of the expedition, (ii) the methodology to be employed within the study to be pursued and (iii) the logistics for the expedition.

In order to focus and plan the logistics of an expedition more appropriately, there exists a taxonomy of expeditions with experienced personnel/authors (and their literature) who are available to offer advice on current knowledge/best practice (and give/hold Courses/Seminars/Conferences/Hands-On Training, etc.) about techniques for success, safety and survival in each category. The categories used by explorers and military are:-

Desert Expeditions;
Tropical Forest Expeditions;
Polar (arctic/antarctic) Expeditions;
Mountaineering;
Caving/Pot Holing and Subterranean Expeditions;
River Expeditions (i.e. canoeing and river-rafting);
and Underwater Expeditions.

Many of the experts in the logistics (and planning) of expeditions in all of the above categories are ex-military/Servicemen; e.g. the RGS's expert on desert expedition logistics is Tom Sheppard, who is an ex-RAF Squadron Leader.

Past examples of some military personnel involved in expeditions and associated logistics are:-

Sir Francis Drake (1540-1596) - English Naval Commander - first Englishman to circumnavigate the globe between December 1577 and September 1580.
James Cook (1728-1779) - Navy Captain - circumnavigated New Zealand, charted parts of Australia, sailed round Antarctica and discovered several Pacific Island groups. Thanks to his dietary precautions, there was only one death among his crew(s).
Sir John Franklin (1786-1847) - ex-Navy - who died in his quest attempting to locate the arctic north-west passage through Lancaster Sound and Bering Strait in 1845-1847.

Sir Robert Falcon Scott (1868-1912) - ex-Navy Captain) both died on the return
and) from the 1911/1912
Lawrence Edward Grace Oates (1880-1912) - ex-Army Captain) South Pole expedition.

Umberto Nobile (1885-1978) - ex-Italian Air Force General - built dirigibles (balloons and airships) and flew over the North Pole twice in the 1920s.
Sir John Henry Cecil Hunt (1910-) - Army Colonel - led, and planned the logistics for the first succesful conquering of Mount Everest by Sir Edmund Percival Hillary and Tenzing Norgay (byname Sherpa Tenzing) in May 1953.

Consideration must be given to the timing for expeditions and explorations - seasons/weather/climate, etc. - of the targeted area/region of investigation, with the advice of selecting the most favourable time and conditions in terms of their being the least harsh and providing the easiest accessibility. However, it is recognised that sometimes it is these harsh conditions/environments/weathers/climates which are the purpose/topic/focus of the expedition/exploration and, therefore, greater attention/impetus needs to be given to the logistics planning.

The descending ranking of real reasons for deaths in expeditions/explorations are as set-out and compared to the romantically perceived ranked notion(s) in the Table below. Apparently, the overloading of vehicles was a very common bad practice and contributed largely to road traffic accidents (and breakdowns), which was the highest ranked cause of expedition/exploration deaths.

Perceived	Real
Infections (Lassa Fever, Yellow Fever, Rabies, Plague) Venomous Bites, Stings Attacks by Animals Cannibals Sun Stroke	Road Traffic Accidents Drowning, Falls and Other Injuries Altitude, Heat Exposure Homicide Infections (Malaria, AIDS, etc.)

Taken from: Prof. David Warrell - Centre for Tropical Medicine and Infectious Diseases - Oxford University, (given in a lecture at the Royal Geographical Society (RGS), 1 Kensington Gore, London, SW7 2AR, 18th. November 1995)

Above Table: Expedition Mortality

From the Exhibition of expedition logistics and equipment at RGS during a two-day conference on "Expedition Logistics" the following were prevalent:-

Portable flat-pack, easily assembled and dismantled equipment and tentage.

Portable protective casings (usually aluminium) for delicate/sensitive instruments/meters and analysis, or testing/gauging, equipment. Also, many tailor-made/specifically packaged protective cased instruments/meters/equipment.

Equipment that was multi-purpose - i.e. dual/triple/quadruple purpose.

Light-weight and low bulk of equipment/food and other things that need to be carried.

Low friction, water-proof and light-weight human 'pullable' hulls/containers such that equipment, food and medical needs can be 'dragged-along'.

Appropriate/dedicated designed equipment for each of the different expedition categories listed above/earlier.

Appropriate range of clothing (of which there is much variety designed/tailored for different conditions) for the expected environment/climate to be faced/encountered within the different expedition categories listed above/earlier.

Water-proof, durable and light-weight hold-alls/knapsacks

Water purifying tablets.

Dehydrated/powdered foods individually packed/containerised for minimum waste, low weight and low bulk.

Food calorie in-take, expenditure and appropriate food calorie ranking charts.

Bio-degradable packaging.

Techniques/advice for dealing with human and other wastes.

Radio/communication facilities/aids.

Medical advice and survival aids.

High emphasis and practical advice was given/placed on proper detailed planning and personal safety considerations.

Some of the points that came from the lectures/seminars/advice groups/work-shops and interviews were as follows:-

Always seek permission from the country's/region's/area's relevant authorities if necessary, telling them of your purpose/reason for the visit/expedition, when (the actual dates) it is to take place and its approximate duration. Obtain advice on any hazards that may be prevailing at the time - anything odd/strange, terrorist/guerrilla groups, thieves in the vicinity, recent weather conditions, proximity to villages or

populated parts, nearest medical centres, closest main roads/routes and railways, etc.

Study the best detailed maps for the area(s) in question.

Costs of logistics for an expedition cannot be ignored and keeping these low/cheap takes much planning and thought.

Overloading of vehicles/trucks is a false economy - breakdowns and accidents.

Sometimes the offer/donation of goods/equipment will be less value that the cost of their transportation to the place of use; hence the transport costs/charges could be more than if these goods/equipment were bought at the place/country of use.

Some Missionaries have light aircraft and usually they are very happy to help-out people on expeditions for a small charge - much cheaper than normal commercial rates and they often can get you closer to where you want to go than does/would a standard commercial route.

As far as possible always use the established logistics/supply structure/infrastructure, because this represents the *least* risk scenario.

Only set-up a specific/special logistics/supply structure/infrastructure when no other alternative exists.

Very often a 'links and nodes' supply chain (where the nodes are 'camps' set-up for such purposes) is used for expeditions - particularly mountaineering. A principal base - usually called 'base camp' - is normally set-up as the 'first' or 'mother base'. Col. John Hunt used this system/arrangement to support Edmund Hillary and Tenzing Norgay (byname Sherpa Tenzing) when they reached the summit of Mount Everest in May 1953 (Reiss, 1990:13; Bonington, 19xx:162).

Establish a regular/frequent contact/radio/telephone time/point with an outside party, and keep to it. At these contacts/conversations pass on your location and any issues/problems/sensitive matters both solved and unsolved as these are possible indications of problems and they will be the starting point(s) by your outside party if contact is lost, and/or should a rescue mission/action be necessary.

Try not to give too much as, or too expensive, a thank you gift to any local tribes/helpers, as this raises their expectations and hopes for subsequent expeditions/visits/studies. Think of those following you.

Always document the details of the logistics/supply/support of your expedition as this is useful/helpful to others who wish to do something similar. Always broadcast anything out of the ordinary and worthy of wide dissemination because of its usefulness.

An example of a current/present/recent expedition or sporting/adventure mission where the detailed logistics planning was essential is the attempt to circumnavigate the earth in/with a balloon-airship. After many recent unsuccessful attempts by teams as well as individuals, a two man team did so, they successfully completed it in March 1999. This 19 day aerial circumnavigation by Brian Jones (British) and Betrand Piccard (Swiss) in their Swiss sponsored "Breitling Orbiter 3" balloon was completed on Sunday, 21st. March 1999.

Sources/references in addition to the Conference/Exhibition and interviews:-

Bleeke, J.A. (1989) "Peak strategies", *The McKinsey Quarterly*, Spring, pp 19-27

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Reiss, G. (1990) "The Ascent Of Everest", *Project Management Today*, October, Vol. II, Issue 9, pp 12-14

Winser, S. and McWilliam, N. (Editors) (1992) *Expedition Planners' Handbook & Directory 1993-94*, Royal Geographical Society, London

14.8.1 Data Sheet And Findings From Case Study E1:-

Goals/Objectives:

Safe and sustainable expeditions of scientific/knowledge gaining benefit(s) and sporting achievements.
To have logistics contingency plans ready to deal/cope with any possible mishaps/problems.
The principal purposes of expeditions are 'discovery', 'curiosity', 'adventure' and 'sport' - and this means the discovery of associated logistics problems too that can be defined/understood/solved and passed on to others that follow and have to endure similar experiences.

Strategies:

RGS grants for expeditions are not awarded until 3 aspects are defined/satisfied viz: (i) the purpose of the expedition; (ii) the scientific methodology to be employed for the study; and (iii) the development and existence of a credible logistics plan to sustain/support the expedition.
Make the most use of established supply systems; only set-up special/purpose designed ones when/where the established channels/chains/networks are not available.
Specified/regular time slots/times for contact/communications with an established central body/person.
Be 'trackable' and 'traceable'.
Picking/choosing the least harmful/most gentlest weather/climatic/seasonal conditions/timing.

Characteristics:

The types of encountered terrain and specific environmental logistics requirements/support (e.g. appropriate clothing) are classified under the expedition environments of: desert; tropical forest; polar; mountaineering; caving; underwater; and rivers (i.e. canoeing and river-rafting).
Diseases, accidents, being robbed/kidnapped and encountering guerillas are very prevalent. (The risk of getting infected with HIV, and the AIDS virus is so considerable that a blood transfusion in the third world now carries an unacceptable risk.)
Vehicular (and other equipment) breakdowns are common (e.g. because vehicles are overloaded).
Many large scale, or important, expeditions have had their logistics planned and supervised/managed by ex-Service/military personnel.
Sponsorships and contributions/help/aid can be sought from commercial (or other) organisations. (But - beware of supplies/equipment being given/donated at the point of initial departure - often the cost of transporting/ferrying the same to point of use/need is greater than the value of the donated inventory; try to negotiate the donated goods/supplies/equipment to be picked-up by you close to, or at, the point of use/need (i.e. geographical postponement and/or proximity placement(s)).

Principles/Concepts:

In depth planning and several series of contingency plans (i.e. 'what/if' scenarios?) - forecastability.
Educated/knowledgeable participants (cognizant of the practical logistics and medical implications).
Reference to (and contact with participants of) previous similar expeditions and understanding the then encountered problems and the possible solutions.
Portability of equipment: lightweight; low bulk; compactness; multi-purpose; and protection/protected.
Flat-pack arrangements for ease of assembly and packing-up/away plus ease of carrying/portability.
'Nodes and links' chain arrangements (e.g. a 'base camp' and subsequent closer storage/support camps).
Powdered (dehydrated) foods packeted for individual portions (to minimise waste). Water purification tablets.
Removal of problems, and medical precautions to be implemented, prior to any expedition (e.g. a first time polar expedition member has his/her *appendix* removed before embarking on an/the expedition).
Development of relationships with all parties concerned and encountered (national, regional and local).
The carrying of an appropriately stocked 'first aid' kit/box (i.e. expedition environment related).
Be imaginative: e.g. it is quite cheap to hire/charter Missionary owned light aircraft for transport.
Adequate and appropriate insurance cover.
Write-up/record of the logistics aspects of the expedition to preserve and disseminate the knowledge.

Performance Indicators:

Survival rate: lack of fatalities/casualties; the safe return of the participants.
The matching/appropriateness of facilities to any incident/problem that occurred. Experience and training.
Advancement/progress/coverage per day (km/day; m/day).
Consumption and/or requirement rates (items/day; volume/day; capacity/day).
The logistics aspects/knowledge of the expedition have been written-up and archived.

Dimensions:- • Personal fitness/health level. • Sustainable duration or time (hr and days). • Costs (£). • Weight (kg); Cases (number off); and Distance (km). • Camp area (m^2); and cube bulk (m^3).

14.9 Commercial Case Study - C1

Introduction

This was a High Street multiple store consisting of over 280 stores nationwide - with some stores abroad. Whilst expansion abroad was a part of its corporate strategy, some 80% of its revenue came from the UK stores network.

The case study took place in three parts:-

(i) Visits to Head Office where interviews and discussions with various personnel took place;
(ii) A visit to a self owned and managed chilled and ambient food regional depot; and
(iii) A visit to a retail store in a High Street.

Head Office

Interestingly, whilst this case study was being conducted, the Army had some soldiers here too (from Donnington BOD and the Catering Corps) who were learning how business/commerce carried out logistics.

There are three main areas that play key roles in logistics: the pressure to *reduce costs* (the company saw logistics as an expense); efforts to achieve *time compression*; and the fact that logistics has become *IT dominant* (they were completely dependent on IT/IS "... *no IT, no logistics* ..."). This last point has attached to it - not just the collection of data, but - how to use that data? - Intelligence came from EPoS and information came from O-LAP. Some subsidiary aspects that play important roles are: space reduction; reach and/or range; accuracy of stock details and picking; demanding quality and service from their suppliers/contractors; coping with peaks (i.e. high demand periods); and educating/training employees in logistics (some of the people interviewed possessed a degree in logistics which was gained via the sponsorship of the company). By these principles, the objective was to *maximise availability* of products at the stores, but to *minimise inventory* throughout the supply chain/network.

Some of the tactics being employed were: expensive High Street property to be used for sales space/area, <u>*not*</u> for warehousing/stock-rooms; the stock-room for each store is 'out-of-town' (i.e. at a regional depot where land/property is much cheaper); visibility of what is happening throughout the supply chain/network on the screen; suppliers and contractors have access to this data too; 'pull' - demand led system; composit depots that supply stores with fashion/apparel goods are a maximum of two hours away from the stores; and whilst partnership principles are applied and practiced, they purposely ensure that they possess the power to *control* the supply chain/network behaviour. The partnership principles they use are: long term relationships with suppliers and contractors; pay the received invoices for services and goods on time; share all (and any) infomation (naturally, contractually, such information is confidential and cannot be shared with/passed to anyone else); and if difficulties/problems arise they work together to resolve them.

Their main guiding factor is to continually reduce the distribution costs as a percentage of Sales (currently at 3.5-4.0%). Other measures that were pertinent were: to increase availability; reduce waste; improve on-time delivery; attain stock accuracy; improve pick accuracy; improve data accuracy in general; and they were trying to ascertain the logistics cost per tray, per item, etc., so that they could establish what part of the buying/purchasing margin was absorbed by logistics.

Other ideas/principles that were being pursued were: better and faster (i.e. real-time) IT systems/infrastructure; better analysis of the collected data (i.e. O-LAP); to improve product launches/introductions and the management of them; to achieve synergy by combining currently separate sytems into one - an example was to move towards multi-

product deliveries instead of the current four categorised product groups which were handled/administered/managed separately. This was considered necessary because of the different bulkinesses, weights and value densities of the many products; an interviewee quoted: "... *look at the proportional differences between a £10.00 piece of beef steak and ten pounds worth of potato crisps.*"

In the main, the Sales profile/shape is similar year on year; they know when their seasonalities are in a general sense (i.e. the months and certain periods) and some lines are only offered in particular seasons. However, the whole range of sold goods meant that sales of one product could be every 90 minutes and the sales of another could be one every three weeks. Suppliers/manufacturers were selected for/via/because of technical ability rather than detail. This company looked upon manufacturers (i.e. their suppliers) as "retailers without shops" so they were empathetic to 'swings' and 'forecastability' issues/problems; to help their suppliers they book/reserve manufacturing capacity and the details of what has to be produced/manufactured is given closer to the need for it/them. Apparently, for the apparel/styles/fashion items, their manufacturers can change styles in hours - which is why they were selected - using many of the QRL techniques/ideas. Also, for some items/products which come from abroad, a retainer is paid to a contractor to air-lift these in when appropriate.

Forecasting the demand of individual items is difficult and some statistical analogies are used - they try to gauge/estimate product-life of their products/items; although they claim to predict/forecast/know food demands to within 10%. They monitor sales daily and categorise products that are <u>*not*</u> moving/selling. Analysts are employed to advise/predict/watch matters like weather/sports events and seasons/fashions/crazes, etc. However, they were cognizant of the fact that they did not know the potential sales that they have lost, for any reason, let alone for logistical ones.

The general management approach/style was not necessarily based on 'risk analysis' in the accepted sense, but more behavioural; as one interviewee put it: "... *our executives love their merchandise and their level of involvement is immense ...*".

Food replenishment to stores is daily; textiles (which was weekly three years ago, improved to bi-weekly, and now) currently at three times per week with the objective of becoming daily. With these frenquent 'calls' there is no need for priorities "... *priority is an obsolete concept, daily replenishment is the goal ...*".

The company anticipated <u>*no*</u> computer millenium compatibility problems because they were planning to introduce a new improved customised software facility, well in advance to debug any problems found. The new software was year 2000 (Y2k) compliant. They have made it mandatory for their suppliers and contractors to continue to do business with them, they too, must be compliant. However, in most cases, apparently, the company provided the software for use by their supliers/manufacturers/contractors - this ensured compatibility, proper protocols and eliminated any interfacing isuues/problems.

The hypothetical logistics type matrix was accepted and they all said it applied to them. Quadrant one was every-day life. Quadrant two contained special Mothers' Day/Fathers' Day and Christmas/Easter/seasonality products/items as well as some local single supplier purchases like bread. Quadrant three held Exhibitions/New Stores/developments and pro-active projects being tried-out/tested before moving into quadrant one; also some special National Holiday/Jubilee products. Quadrant four was particularly the apparel/textiles products.

Regional Depot

This was basically a composite, cross-docking, ambient and chilled food distribution centre. Products, SKUs and containers had unique codes (i.e. barcodes). Bulk supplies

came in from the manufacturers/suppliers; these were electronically 'read-in', broken-down, picked, cross-docked and consigned in wheeled cages/containers to particular stores according to screen data. Some goods received were pre-consigned to particular stores - these were just 'moved across'. The out-going products and containers were electronically 'read-out'. Layouts for the flow of goods/containers/pallets in the depot, and for the truck traffic outside were of good design and had been well thought out. The temperature of the chilled food handling area was monitored and managed with a daily gyro-graph record taken and kept. Fork-lift trucks, extendable roller conveyors and people pushing wheeled cages were the main types of material handling methods. All unused carton from boxes was flattened, collected and dispatched for recycling.

Training of staff was a crucial part of achieving quality (accuracy and hygiene), service (responsiveness, speed and timeliness), cost reduction (productivity, waste reduction, labour reduction and encouraging suggestions). The whole depot was very clean and tidy with a high activity level - it had the feeling of everyone knowing what they were doing.

An interesting feature of this depot was its role as the company's national depot for wine. Wine was purchased abroad, from many countries, in bulk (i.e. unbottled) and transported to the UK in tankers (or bowsers) constructed within an ISO container compliant/handling framed lattice. Obviously, container handling facilities were available on site. The depot had a bottling plant which bottled the different wines and cased them. These were then distributed to the other regional depots operating for the company and of course it supplied this depot for its stores. (This was postponement in the form of packaging (i.e. bottling).)

Retail Store

A visit to a High Street store was useful as I was shown the laser scanners used to read barcodes of merchandise and cages/trolleys/containers coming into the store via a very small receiving area. (Having no stock-room at a retail store was the policy of the company.) Most of the foods came in plastic containers/tote boxes which could be loaded onto a wheeled platfrom/base. The cages/racks/platforms/bases were handleable by people of the slightest physiques - they were well designed. The in-coming goods, particularly those that were caged, were consolidated by departments, so that an in-coming trolley/cage went straight to the department for which it was consigned. (This was an added-value aspect conducted for the store at the depot. Another added-value function that was carried out at the depot was the hanging/arranging of apparel mechandise onto mobile display racks/units for the store; these loaded racks/units were then rolled-off the lorry, barcode scanned as having been received-in, and then rolled straight onto the pre-arranged allocated sales floor space ready for customers to view and select. I was also told that in some/other stores, the outsourced depot operator re-filled the shelves during the stores' closed hours - this meant that the stores' sales staff concentrated on their role of servicing/helping, and selling to, the public/customers with no distractions of having to fill shelves.) Empty cages/racks (and any returned, or non-selling, lines/goods) were returned to the depot via the delivery lorries on their return journeys.

Sales to the public/customers were scanned and recorded via EPoS (the collected data was transmitted to the supplying depot, the suppliers and Head Office). Stock-taking at the store could be achieved electronically (because of the data capture facilities) and this was done at the end of every month where the comparison with their monthly stock targets would be conducted, and if necessary, things were changed as a consequence. Physical stock-taking would be conducted every six months and the accuracy level checked/correlated with any discrepancies investigated and rectified accordingly. I was told that the IS, which was automated as far as possible, could be over-riden manually by people who were given the appropriate security clearance to do so.

14.9.1 An Interview Transcript Sample From Case Study - C1

SLO is Silverio L. Ostrowski, the interviewer and the researcher/author.

SLO: *What do you consider to be the similarities and dissimilarities between commercial and military logistics?*
Reply: That's quite a difficult question, I don't know much about military, but, just off the top of my head, albeit I think things are changing, the pressure on costs in the retail side is extreme, we're always trying to squeeze money out of nothing, on the military side I think there is a lag in there. I also think I'm sure the military would profoundly disagree, but having sort of been to a few lectures, time compression is very extreme in the retail side at the moment as well. If I look at the food depot we'll get stock in at midnight tonight and its in store 6 o'clock the following morning; and you talk to the military and they talk about quick response and over distance I think it is, but when you look at some of their warehousing side it's actually - it makes you cringe. So those things strike me, the other thing and this is speaking from total lack of knowledge, but I think on the retailing side the use of IT is vast and millions thrown over it; but I get the impression on the military side IT is used a lot but it tends to be sort of massive defence machines I suppose to the massive defence computers as opposed to probably moving information. Buckets of data but I not sure its actually used in logistics, and probably the other thing I would say is scale, em, I think a lot of the military organisations are global, a lot of the retailing sides are what I would call national, some may be vaguely international but th're very few that are global. When you look at sort of like y' know United States Air Force I mean they are what I would call a global organisation virtually. I guess those are the immediate things that would strike me.

SLO: *Fine, that's very good. What about historical evolutionary impacts on current logistics, you know the practices, principles and control systems?*
Reply: In what sought of context, gimme an example?
SLO: *Okay, what were the stimuli that prompted logistic advancements?*
Reply: Okay, I think from my side, I think there's all the background of how all the supermarkets came across in the '60s and the power swing from manufacturing towards retail I think sort of rapidly coming up to today particularly in the UK in the '80s on the food side certainly the move towards control in distribution, improving the service at the back of the store, improving replenishment cycles, giving better customer availability; those things have really driven through I think particularly in the '80s, and I also believe within that the role of IT has been crucial and again if I sort of go back to the '70s you 've got the sinclair calculator which then cost £150 and might work by the early '80s we've got PCs and then towards the back of the '80s we've got y' know computing power that's phenomenal and I think a lot of that is really help drive logistics, but I think the swing in the power base has been particularly interesting and also the degradation, particularly on the retail side, away from small selling units in terms of y' know where everybody used to have a village shop, everybody used to have a corner shop that's all gone, and I think when you sort of lay over some of the social and economic changes, y' know look at how many people have got cars now compared to 20 years ago, I think those sort of things have had a massive change on the way the retailing cycle has changed and I think you then back onto that the logistics cycle - y' know - retail or shop-keepers used to buy from locally from the local farm and all of sudden those have all been condensed and retail has become very powerful conglomerates with huge buying power and they've really taken a hammer to the manufacturers and totally reorganised, albeit not necessarily deliberately in some cases, the way that the logistics is handled today. I could go back much further, I would actually say, my own perspective, you look at the history of logistics in, sort of where does logistics start, I actually think the military are very good in terms of using them as a role model to say, y' know, military created the concept of logistics way back - whenever the Romans were about war or the Greeks marching across the land - but in terms of looking at the evolution of retail logistics I believe that's

something you'd actually talk in the last 25 years probably. My boss has got a wonderful picture in his office and it's the Napoleonic campaign to Moscow and it starts off with 446 000 troops and the line - its got time and everything - and the line as it gets towards Moscow gets thinner, as it comes back it gets even thinner. That was a great example of bad logistics because Napoleon has got 10 000 guys left so he's killed off virtually half a million. So I guess that's a bad organised logistics campaign. Back-tracking to make it a bit more specific to XXX, I think XXX has actually been - it's very intresting if you look at the development of their logistics particularly, again over the last 15-20 years because until sort of like the late '60s foods was not particularly big in XXX it was textiles and all the textiles were delivered by the suppliers direct. The very early 70s XXX decide to centralise its grocery distribution which was tins of beans or tins of fruit or whatever and it started with one depot in Kent - a very small organisation. Those number of depots grew throughout the '70s but XXX was very early into what's now is called composite distribution albeit it wasn't recognised at the time as composite depots, and that was quite evolutionary at that point in time. Again its interesting you look at XXX it had an own brand - xxx - whereas all the other retailers where 10 or 15 years behind them, so XXX were in very early. If you look at the textile side, again the early '80s all XXX stores, and I think this is quite interesting evolution here, XXX was trying to improve its impact in the High Street, give a better offer, and one of the things that had to be changed was logistics because historically stores had loads of backstage space holding stocks. And the Board said I need to expand in the High Street, I can't afford to keep buying these shops they're expensive items to buy, where do I go now as we've got another room upstairs full of stock? Strip the stock out, hold that somewhere else and initially, every store then had an out-of-town stock-room, and somebody came along and said this is ridiculous y'know we've got 300 stores, we've got 300 stock rooms, now let's consolidate those down into warehouses. And from that grew 15 multi-user warehouses, and again if you look at the early '80s in XXX particularly in textiles side a phenomenal amount of money was invested in IT to drive those stocks and build those warehouses, again you're looking at something like 3.5-4.0 million square feet of warehousing space. That's been interesting because again you can see the swing y' know the suppliers getting direct, also someone saying 'hang on a minute' this is no way to do it; improve the service to stores, release selling space. So some huge changes, but IT from our point of view very, very crucial in all that, IT's been a real lever to allow us to drive stocks through.

SLO: *Great. What do you consider to be the variables that are necessary in logistics and used by retailers? Qualify why.*
Reply: Give me an example, just ...?
SLO: *Yes, one is time obviously, speed is another, others are space and for global logistics, 'reach' for instance.*
Reply: I think, if I look at foods which is something I'm sort of very closely involved with: time has become more and more important. Again, if I give you some examples, start with the replenishment cycle, if you go back sort of 15 years, every store had what was called a check-in list, and every Saturday they used to record the check list how much they sold during the week, how much stock they had in, what their stock positions were, based on that, that information will all go back into head office and punched into the computer and from that we would then order stock, broadly you were in a two week cycle, so you would order today what you would need in two weeks time. The problem with that was there was loads of stocks in the supply chain. XXX first of all made use of IT to say how do we run that better? Computerised the store check list by making good use of EPoS collect the sales data, stock system and the rest of it, recording all that through, and what that then started to do was to reduce the order lead-time for a supplier so if it was two weeks, today it would now be down in some cases 12 hours. And for the logistics function I'll give you an example of what happens today so that's what used to happen, today we will lay an order off to a supplier at 6 o'clock this morning he will be into a depot seven, eight, nine o'clock tonight and that stock be in store the following morning, and we're now even looking at shortening that lead time even more and its

interesting because you say well what's the cost of shortening the order lead time? because you're moving a lot of the operations that used to be done in various times at the cheap time of the day on a cheap day of the week, we're now moving it to follow the sales profile which is very much towards the back end of the week into night time working, but speed is very important, the reason speed is important from our point of view is responsive replenishment, because if you sell out you want to be able to get it there tomorrow it's no good telling your customer its going to come next week, freshness plays a great role in that; so speed is becoming more and more critical and that's speed of movement, but also speed of IT - processing power and if I can give you an example the way we're fixed, today we collect sales information from store once a day, we make from that sales collection decisions for the next day. What we're now starting to say from a replenishment point of view is y' know in five, ten years time we can see real time sale's screen so every time you sell something you get a bit of data then drives a decision and we can sort of virtually see - theory at the moment - but real time replenishment whether its just in time is as I said for debate, but real time replenishment so y' know if y're selling a sandwich, a particular one at 10 o'clock in the morning and you know the sales profile is x, y, z, can I get some more sandwiches, can I draw some so ... a store down the road that's not doing so well, can I divert those sandwiches on the lorry to another store and that's the way we're thinking today, so time is crucial. Cost we've touched on, but one of the big drivers in XXX particularly on the distribution side is very keen to see a fall in trend with regard to distribution costs off set to sales, and we're driving costs through in a big way at the moment we're now started to broaden that out and understand that a bit more; and if you go back a few years, there would be no horse trading in the supply chain, the sort of things we do now, an example, something we did 3 years ago was you never like to put your budget up because if your budget goes up you're seen as sort of failing, but we actually said to stores what sort of service would you like and stores said that we want more of a value added service we want ... we don't want these big cumbersome pallets you send every day and we don't want all the stock mixed together what we want is all the sausages together and all the yoghurts together, we want a nice little pallet that a little girl can handle as opposed to a 6 foot 6 hulk, and if you provide us with that sort of facility we can take the stock into the store later because we hav'n't got to do so much sortation on it, and I'll give you the figures, distribution cost went up 2 million, stores savings were 10 million, and those are quite phenomenal figures, so cost was important, in reducing it within budgetary areas is high on the agenda. Understanding there was cost in the supply chain is a fairly novel feature in XXX and is only now starting to come through but it is very, very crucial. Other drivers, you touched earlier on the principle of reach, an example of some of the things we're looking at the moment for Europe, I deal very much in the UK but then have a role in Europe, foods in Europe has been quite small, we're now expanding that market: we have a depot in Paris, we have one in Spain and those depots are not really giving us economies in terms of servicing small volumes it doesn't give a very low unit cost, the systems over there ... we don't have global systems yet European systems are not particularly sophisticated what we're now looking to do is to extract a load of the work content which is currently done in Paris to service the French stores and bring that back into a UK depot and as you say reach out to the various parts, and the interesting thing within that is we can actually reduce costs and improve service as a result, so, reach is important providing its sensible and again, y' know we ... people talk about distance and get very upset when you talk about servicing Europe from the UK. One of the depots we run is in Thatcham, we service the south west and that, Falmouth is 6.5 hours away, we service Paris from Faversham and its less than 3 hours away. So, time, costs, space is an interesting one, I think sometimes people get very confused about space they say y' know you must operate within a fixed plotted space y've got, what y've got, and that's it, my view it depends how expensive the space is? because flexibility is very key and if you minimise space you're actually effectively ... or you can be accused of having an optimum space requirement out of peak and not therefore having it at peak therefore you compromise your service levels at peak. Within XXX there are a lot of debates about

that, people think that space is expensive, but when you look at it as a % of total logistics cost it's actually quite small, but it's certainly high on the agenda and I think one of the reasons space is high on the agenda is XXX uses a lot of 3rd party contractors and when you use space through 3rd party contractors you tend to get tied into contract and people don't like to getting tied into contracts because of flexibility. So, space, space is important but I think sometimes it's over emphasised. The other sorts of things that ... I mentioned reach earlier and if I expand into textiles now, foods we're quite comfortable servicing places a long way away but one of the things that you will see in XXX some of the autopsy coming through from very high orders from the Board, and some simple philosophies and principles which are very difficult to break but do have an impact on the way you run your logistics operations is a store sha'n't be more ... mus'n't be more than two hours from the textile depot; because they see that as being crucial and those things have to be dealt with at times.

SLO: *Some companies like B&Q are choosing to have one centralised national warehouse in central England - in the triangle circumscribed by the M1 - M6 and M42 motorways because they claim to be able to reach 95% of the country within 4 or so, hours; this helps with the square root law as well. Any views on that?*
Reply: I always find it quite interesting because I think people are lulling themselves into a false sense of security at the moment 'cause I think that one thing that people forget, and people do have very short memories, I'm reasonably young; but industrial relations, and the industrial relations environment is very stable at the moment and there are loads of people that hav'n't got any work. You just need a swing in government, a Labour government comes in, and I think, I'm pretty certain that as quick as the Tory government were keen to sort of take some of the old Trade Union Laws away, I think that Labour will be keen to get certain things back in and I think those people that have a central operation, if they don't manage their industrial relations, could be exposed - just a comment I've read. Just the other thing I think is worth mentioning about the food operations at XXX is all the warehouses, apart from a very small amount of space, don't hold any stock everything is in transit, and that includes ambient, so y' know biscuits come in and biscuit go out and everything's got a 12 hour cycle; and again that's quite interesting when you look at the concept of a national depot in terms of the square root of stock and everything, it's not something we consider and if you look at the breakdown of cost on the food side, and again, compared to something like B&Q, B&Q won't be going to every store every day and XXX with food you're going to every store every day and transport - the more depots you are running/have, the transport cost not surprisingly comes down and there is a balance in there in terms of number of depots and I would argue that the right number of depots for XXX is 7. We've ascertained that by doing the classic: where's the new curve and where's the right number of depots? and we've done that exercise and 7 is the right number we're convinced.

SLO: *Fine, okay, but the 7 depots you have got has been arrived at with existing data or forecasted data it has not been arrived at by what I call - hueristically?*
Reply: No. Broadly, taking the sales by store and a very simple location model and said y'know where should we be, I tried to take into account - assuming there's 5% growth - but you can never take into account reasonable differences it's just a sort of blanket approach. XXX's what I would call (I'm not sure some people would agree with this but it's my personal view) XXX is very into what I would term a tactical company, its not a strategic company so for me to go along and say you need 7 depots and these are the locations people say: "Well that's jolly interesting but tomorrow there'll be out of date!" - and actually they're right; and I would say XXX does lie somewhere between the two, it does rely on a lot of 'gut feel' but is does like a bit of empirical evidence around it, and it won't be dictated to by mathematicians from the modern public, please yes. So, its probably quite interesting from that point of view.

SLO: *And quick response?*
Reply: Quick reponse to us is: knowing that you've sold it yesterday, laying the order off this morning to know that you're going to be able to replenish it tomorrow. So we don't hold stocks, and the interesting thing is if you look at the fluctuations of volume through the week they're quite phenomenal and one of the problems that we encounter on occasions, because you can't always predict how people are going to buy things or indeed what they're going to buy, is having a response flexible enough from the supply chain to cope with it, because you say to a supplier double production overnight and he'll sort of splutter "well I can double some of it but its going to come in late" and we sort of say well hang on a minute what's the estimate for the volume - well we don't know yet. There are some interesting issues to tackle in quick response. We're not fond of stock on the food side, and on the textile side we do have stocks, but those stock levels have come tumbling down and I guess at the end of the day its a lot to do with the manufacturing cycle.

SLO: *How does logistics vary according to different market segments? Food versus clothing versus furniture versus soft furnishing and any others they may have.*
Reply: If I take foods first of all: I guess we've got on the food side in very crude terms we've probably got 2 logistical flows operating. We've got what I call short life products which is cold chain: salads, delicatessen, ready prepared meals, that sort of thing - no stock whatsoever, daily delivery to stores - I would call a quick response in terms of from placing order to receiving it in store is less than 24 hours. Not a lot of space to do that in, I'll give you some numbers: on the food side we'll move 100 million trays a year and we'll move that through about 600 000 square feet in total and we turn over our space very quickly then, in the depots its: in, picked, out; in, picked, out; we operate sort of 2 cycles per day, one for the cold channel that's quick response, wafer, and some of the short life ambient: cakes, some of the fruit & veg; we then have some of what we call, again its not recognised from the business but it's there, what used to be called historically long-life merchandise which is biscuits, crisps that sort of stuff, which doesn't tend to be delivered to the depots daily but will come in sort of 2 or 3 times week and stores tend to hold a reasonable level of stock on that, that will come into the depots the opposite 12 hours to the cold chain, so what we'll do - we will feed a store of cold chain in the morning pre-opening which is pre-opened so we can get it on the shelf so its fresh and its ready for the customer. The long-life stock takes the goods to the stores in the afternoon which is then filled late afternoon again to the stores ready for the following morning, that way we would tend to optimise transport and warehouse space but again no stocks from a warehousing point of view, some of the suppliers may hold a particular long stock - the longer life stocks upstream they may produce them in economic batch quantities then hold off and then we'll effectively call them through, but from XXX's point of view we don't have any stock other than the sales floor. Frozen is somewhat different, as I say on the cold chain ambient side we've got 7 depots and around 600 000 square feet and these are the depots that service the regional stores. On frozen we've got 2 depots, one in the north, one in the south, we will be sitting on somewhere between 2 and 3 weeks stock of frozen. The interesting thing about frozen from our point of view is - it appears from a distribution point of view, not from a sales, from a distribution point of view to be a bit of a declining area, volumes are dropping the drop size to stores are therefore smaller and therefore the unit cost is going up in frozen. In the frozen area, we are doing a lot of work to say can we push that frozen through the other depots. So frozen is a bit unique because we hold stocks. So really, I guess, if could put short-life and ambient together albeit ambient and short-life go off at different times in the day. Frozen is a totally separate network. The other thing we do is some imported stock particularly wine, we buy containers of wine from all round the world, we actually hold those in a ... we have a warehouse in Kent we will call stocks off from those. Some people say we could buy better, we could buy it bottled, but there's no point in having quick response from France for two ... or from France or Chile for two cases of wine, you might as well buy a container its cheaper, and its also expensive to move it. And then

you've got textiles, textiles is totally different, its stock holding, stores don't order foods - the system decides what to send it, on the textiles side there is some support to help stores they may make a recommend order, but the stores do a lot more, what I call ordering, and have hand held terminals. Speed is a lot different in terms of speed of sale, y' know if you look at foods there is something like 2.5-3.0 thousand UPCs we take about £2.5 billions/year. On textiles its something like 60 or 70 thousand UPCs taking £3.0 billion, well obviously the sales lines are a lot different and therefore the way you handle those lines is a lot different, the warehouses are totally different they are stand alone IT systems, the textile system cannot cope with foods going through it and likewise the foods can't take textiles. That's interesting because from a logistical point of view someone like myself is saying at the moment you've got this route on foods, you've got this route on textiles, they've both got fast moving lines and slow moving lines at some point we should really be pulling this lot together and getting some synergy from a transport point of view and from a warehousing point of view; and those I think are some of the developments you'll see in XXX in the next decade, I guess. We have our logistics chains as well which people often forget about but are quite important; getting staff uniforms to stores, getting counters to stores, getting tills to stores and a lot of what I would call, y' know, I represent a service part of the business but this is real service stuff y' know. People don't tell you anything about countering or they don't tell you anything about Christmas you've got to sort of y'know, increase the number of tills you've got by 30 and you got to get all those there and there's a separate logistics support system for that, albeit it's quite manual, not particularly sophisticated. So in XXX you've probably got 4 or 5 different ways of getting different products through to the store and whilst they've both been rationalised over time it's only a question of when do they come together and I think the driver there will not be the physical side of things I think it'll be the IT side of things.

SLO: *Thank you. Actually, one of the things you mentioned is very pertinent, because the military do transport multi-products all together.*
Reply: I think we'll move towards it but I still think we're quite a way off and I think the thing that's interesting is: if you look at our systems, our systems now are very complex and to change those to make them common - its a big culture shock and there's going to have to be some quite some benefits put-up to allow us to do that.

SLO: *Excellent. Soft-furnishing you've not mentioned?*
Reply: Soft-furnishing, we have a sort of furniture operation, again its a separate warehouse. Go into a store and you order it and it'll sort of arrive at your house 2 weeks later or whatever. I would say it's (not sure if people in the business would agree) its slow in terms of replenishment, if you order something, people like to have it straight away, and if you can get it straight away I think it's a real buzz; but having said that having compared to a lot of furniture manufacturers I don't think we're bad, but you're talking probably about 2, 3, 4, 5, 6 weeks to get it.
SLO: *You order it and it goes straight from manufacturer to the customer then?*
Reply: It's a mixture, we have a furniture warehouse where we have some furniture, where y' know you might be able to call off oak - I don't know much about it, perhaps there are some faster lines, but there are certain things which are bespoke that come direct from the manufacturer.

SLO: *Okay, thanks. The other thing that I have a pet love for is what I call priority rules or rules of priority.*
Reply: I'll mention textiles first very briefly and again others will be able to tell you a lot more about this, but if you look at textiles and particularly stockholding XXX works period by period (monthly) and reports how its doing and one of the things you'll see there on the textile side is the beginning of the month you haven't got a lot of stock and the reason you haven't got a lot of stock is because people want to meet stock targets, because one thing that's always driving their stocks up and you'll see through the month

the stocks will build and then as the month progresses and stock builds try to push stock into stores and then as the month progresses someone'll go Christ we'll miss the stock target again and it comes down. That is something I pick up internally. On the food side its slightly different in that the drivers on the food side are sales increase is very important, but because food is perishable we have something called waste and you see we'd react to it. If the business has had a bad month in, for example, sales the next month the company goes balls for glory to drive sales and the problem is it drives sales and its waste goes up, we have a waste % figure which if it goes above a certain level people get very concerned about 'cause its straight off the bottom line and foods is always jockeying sales against waste, and one month the flavour of the month is waste and the next its sales. You get this pattern and of course the thing that drives through from that is when you go for sales, volumes are going *bananas*, stores are well stocked, yes sales are up but you're getting hit with waste and the next month we've got too much waste: right, drive waste down, how do you drive waste down you make sure you haven't got as much spare stock, you haven't got much spare stock availability drops down, availability drops, sales drops, volume drops the next month you think Christ, and off it goes again and you will see its not quite as rhythmic as that but you will see mood swings and those're the sort of priorities we very much pick up.

SLO: *That goes for all your product lines? Furniture, wines as well?*
Reply: Not so much wines, you don't really get waste on wine, it tends to be the shorter life lines whatever it be, something like sandwiches, or chicken, or those sorts of lines. In terms of sort of coming down to the sort of micro level the business makes conscious decisions y' know we've just had a scheme, you might have seen it, there was a campaign which was designed y' know to say to XXX, you love XXX and a strawberry was depicted on a big advert I - suppose to say 'love XXX' and everyone thought ah Christ XXX are advertising strawberries, yes we were but it was a bigger scheme about foods and all of a sudden the priority was to get strawberries through and we were getting messages through such as "I don't care how the depots operate but strawberries are coming at 3 o'clock in the morning and you've got to take them, you've got to deal with them" and you then get debates, but hang on a minute we can't cope with them at 3 o'clock; "I don't care what you do you've got to take strawberries" and we will get priorities on a micro level like that, and that is very much a reacting to sale. That can be specific items and we will bend the rules to do that and the flexibility is key when we get to that. So there are prorities and those are probably the best ones I can give at this point in time without really thinking about them, we do have clear missions in terms of y'know right this is what we're going for this year we're going for this sales increase, we're going for this waste figure, we're going for whatever, but in order to achieve those targets you will be going through these various cycles. XXX is driven by the chairman, and it has been - I've been there for two chairmen - and if the chairman sort of has a board meeting on a Monday and he doesn't like what he's seen last week then that will set the pace for the week. If he's been to a shop and he's found something, he's seen a blouse and he thinks the blouse is naff, then business decisions will be made that week and the whole blouse range could come off and y' know decisions are made and XXX are autocratic from that policy point of view. I have worked for two other companies before here and this is the most autocratic. Therefore you will see very short cycle changes. The business actually knows what the chairman is thinking.

SLO: *Lovely. What are your 'best practice' logistics principles?*
Reply: Stockless is something we've achieved on foods but I think something we'll be striving for on textiles and there's a lot of work going on at the moment is maximising availability key within that we are always flogging ourselves to death to try and find better ways of doing things. Best Practice is a word used a lot in XXX y' know, identify the best practice to operate the warehouse and we'll have teams of people looking at various trials at various depots we will then pull those together and we will set what is called a 'model depot' once we are happy we've hacked and honed it down we will then

roll out that model depot and then a year later we'll go back and address it again. We are continuously doing that sort of thing. We perfect one area or aspect and transfer or migrate those practices to the other areas and the cycle for that is very short I often talk to other people at XXX and I think one of the things that is interesting about XXX and it can be guilty of sometimes is not fully evaluating the change that its just put into place. There's often the expectation of 1+1+1 should make 3 and our case it might make 1.5 'cause with so much to roll something out we've got something else coming back behind it and something after that you actually lose what your trying to do. If you look at the amount of change we do it is quite phenomenal, I've worked for 3 companies and I've never experienced the speed or the type of change that I've experienced at XXX. It's almost as though we're looking behind ourselves all the time, Christ someone's catching up, we've got to do something different. It is quite phenomenal from that point of view.

SLO: *My next question is what quick response logistics are you employing?*
Reply: On the foods side I think we would argue virtually everything is on some sort of quick response again it would depend's what the definition of quick response is? Broadly, if we haven't got it on the shelf we want it there and frankly if your a crisp manufacturer or a yoghurt manufacturer or making sandwiches you are expected to respond to that need. Everything is quick, we would prioritise those very much more about getting the cold chain, short life, fresh produce on the shelf before anything else. Whilst ambient products are important to us we're far more interested in getting say sandwiches on the shelf than we are tea. I guess those are probably the main difference. On the textile side, there isn't - on the food side everything goes first class - on the textile side one of the things we do is we call off merchandise from suppliers every Sunday, but we now have the facility to be able to call off continuously through the week and if we're selling something particularly well we'll want to call it and get it into stores and there is now the ability to do that. That is governed very much by sale; I couldn't give you much more than that really. Everything appears to be first class, I would argue it shouldn't be, but that's how we operate.

SLO: *Okay, what are the measures that you employ to ascertain performance of logistics?*
Reply: Again, this is actually an embarrassing question not a problem I'm quite happy to talk about. But if you look at foods if somebody ask the question what is the cost of food logistics? Again depending on your definition of logistics but let's assume that it's buying it, from an XXX point of view moving it through the supply chain and selling it we can tell you what the selling function costs, we can tell you how much we bought it for, we could tell you how much it costs to move it from a depot to a store but we couldn't tell you what it cost a supplier to get it from a supplier to a depot and there is a black hole in there and therefore to identify the total logistics - we've identified the total cost of buying it, moving it and selling it but we can't necessarily break those component parts down. That is something that I think you will see probably change in XXX again in the next 5 years in terms of XXX owns this part of the supply chain, it doesn't own that part but he's not covered in not owning that part its a black hole in terms of time and cost and I think that's an area we will be looking into. In terms of performance measures from a distribution point of view is very much what distribution is as a % of sales, that is a big measure for us; and again we are - the trend is that that is continuously coming down and being pushed very hard for that; and then it's interesting if you look at the figure which is somewhere between 3.5 to 4% and I think most of the industry is sort of 3 - 3.5% you will reach a point fairly shortly where you can't do much more about it I suspect. But then if you look at some of the specifics of logistics, availability, waste (on the foods it will be passed shelf life on textiles it will be something just not selling and you've got to put it into a sale environment and you're losing money; I always view if a retailer has to have a sale he has failed in his selection of his merchandise), when you start to get into more detail again from a physical point of view we have key performance indicators: on-time deliveries - very basic, accuracy - very basic, given again I think where accuracy is

very important; IT systems drive everything so much today that if you are not accurate at the start of the supply chain it's like a pendulum by the time you get to the back end it's all over the place 99% at the start of the supply chain for 1 product can sort of turn to 50% at the back 'cause the error compounds itself all the way through and accuracy's very important, we spend a lot of time measuring accuracy in the depots, I consider the depot as the fulcrum if you like because suppliers make it, once they've got rid of it they don't really care - its in the hand of a third party haulier once it arrives at the depot we often go in there and we spend a lot of time correcting mistakes and then getting it accurate again 'til they drive it through to the next stage. We have accuracy up-dates in the chain which cost time and money, we are now looking at how we can improve that - automating scanning an' all that sort of stuff. When you get into the lower levels cost per case going through, cost per tray, the component cost with various parts of the supply chain whether its receiving, whether its y' know put away, whether its cost of transport, cost of receipt into store, all those sorts of components. But if I had to pick the 3 high performance indicators from the physical point of view it would be distribution costs as % of sales, on time delivery performance to stores, and it would be accuracy. Those are the big 3 key things for us.

SLO: *Okay, excellent. What logistics functions or aspects are the hardest to achieve?*
Reply: That's an interesting one. Because I think XXX doesn't have supply chain managed by one individual, parts of the supply chain are often trying to react to more than 1 customer and balancing that is very difficult, if I take the physical side - synergy in XXX will be particularly difficult trying to combine 2 separate systems together will be very, very awkward and as a result of that rationalisation. People still want to compress time, accuracy requirements are getting higher and higher, again I think there're some interesting debates there - if you go back 3 years ago take a simple one the accuracy of picking would be 98.5% today its 99.5% and people talk about 100% accuracy and I don't think there's always a recognition that to get from 98.5% to 99.5% is fairly straight forward, to get 99.5% to 99.9% is not impossible but there is a cost and there is a cost/benefit in there and its recognising where that balance swings. Costs being on a declining trend is fine but you do reach a point where you can go no further, and the interesting debate there is to get into the full logistics cost and understand the trade-offs and I think XXX has some way to go, our cost curves are reaching the independent area and are probably getting near the bottom but I think we can add them together and get more out of them.

SLO: *Okay, fine. What do you think are the business logistics concerns for the future?*
Reply: Time compression; combining different systems; multi-product distribution instead of separate chains; apart from those I think XXX is certainly an international company albeit 80% of its takings are still in the UK it has a desire to ultimately become global and structuring itself to be global will be an interesting debate going forward. If you look at the moment 80% of everything is made in the UK - if we develop big markets in the Far East and big markets in Europe how long is it before you have to start considering moving the manufacturing base? I guess as a company we would find that difficult in that we are used to controlling it from a central office in the UK. There are some interesting challenges there and I'm not quite sure we know how to deal with those at this point in time - take a textile catalogue of 60 000 UPCs.

Historically, a physical distribution group in XXX, a service area, probably not endowed with the best people and no body actually wants to run it, nobody wants to be in it, today you are seeing people now in the business who actually want to own it, you are getting a food group saying hang on a minute I no longer want to kick it, I actually want to own it because I know its key to how I get stuff through therefore if I own it I can control it and if I control it I can make it meet my needs. You are seeing the evolution of that sort of thinking, you are not seeeing the organisational structure to match it yet but you are seeing people starting to think it, and it only has to be a matter of time before somebody

actually takes full responsibility for the total logistics function. If you look at it in XXX today food group buy it, they control the stock levels, physical distribution move it, stores sell it, I think at some point somebody will actually own the buying and stock control and the moving - the integrated logistics model. Still some time away but I think it will come.

SLO: *I believe I have what I need, I have enjoyed this interview and thank you for your time and contribution. The interview is complete - unless you have any matters/requests that you require from me?*
Reply: No, I 've h'd to think a bit, but it's been okay, I too 've enjoyed it.

14.9.2 Data Sheet And Findings From Case Study C1:-

Goals/Objectives:

Sought cost reductions - to understand the logistics' costs - cost per tray, component cost.
To improve replenishment cycles - make these responsive - seeking time compression.
To improve (maximise) product availability to the customer.
Speed, item and container level tracking of products/goods - barcoding and EPoS.
Minimise stock in the chain/network.
To combine (integrate) systems and other aspects that are currently separate: like moving to multi-compartmentalised (i.e. various temperature zoned) vehicles.

Strategies:

A national perspective of the whole need/operation was taken - will then move to global.
Use of IT/IS - IT was dominant: like automated scanning; analyses/usage of the captured/acquired data.
Out of Town warehousing/services - Multi-user. One 'point of contact' for the store.
Outsourcing of services (provision) sortation, etc.
Partnerships with suppliers and outsourced service providers - BUT - they control, rule, dominate, dictate and have complete charge.
Moved/moulded the operation to follow (closely shadowed) the sales profile.
Stockless - a striving for this state/condition.
Flexibility - for appropriate response(s) to changes/opportunities; being lean and agile.
Major changes were achieved by: changing a selected *guinea-pig* depot - debugging etc. and then *exported* the changed system(s) to other areas/depots.
Logistics *designed* according to the product/fashion/etc. Policy for distribution centres handling fashion items is two-hours maximum away from store.
Knowledgeable workforce - education and training for the staff.

Characteristics:

Wielded power over the chain/network.
Conglomerate with huge buying power.
Benchmark their 3rd. party service providers against themselves and, each other - much computerised data.
Errors compounded backwards - 1% error at the front could result in a 50% error at back.
Food (temperature categories) and textiles currently handled separately - all with various demand profiles.
Work at depots/DCs was very labour intensive.

Principles/Concepts:

Holistic view of the scale of the operation; the magnitude - thus a *designed* network; nodes and links.
Trans-shipment centres/composite distribution centres/cross-docking centres.
Pay their 3rd. party participants and suppliers on-time and where/when necessary shared cabs/trailers.
Speed - textiles DCs maximum 2 hours away (stores are for selling - they are NOT warehouses).
Once a day - 24 hour replenishment - based on goods/products sold. (Priority is an obsolete concept.)
Matched containers/trolleys to product/use/handling/etc., and recycled and re-used.
Use of postponement: both geographical and packaging. Carton recycling.
Speed, and type, of changes were frequent; this has been made part of the culture.

Performance Indicators:

Distribution costs/Sales revenue as a % - (currently 3.5-4.0%) compared to that of the benchmark of most industry of circa 3.0-3.5%.
Trying to get to a 'cost per tray', 'cost per pallet' and a hence a 'logistics cost per item'.
On-time deliveries. Training and staff versatility.
Inventory amount and its accuracy.
Accuracy of pick/delivery/inventory. Productivity measures.
Availability at store.
Waste (% relating to the store) 'past shelf-life' for foods and 'not-selling' for textiles.
End of month stock-targets at the store - observe and monitor/analyse the patterns.

Dimensions:

Cost (£) obviously via its constituent parts: labour/fuel-energy/damages/wastes/space and overheads, etc.
Time (hr) and Range/Reach/Distance/Sweep (km and km^2).
Headcount (number of people).
Number of inventory items, inventory quantity (amount), inventory value (£) and inventory age.
Space: area (m^2) and cube (m^3).

14.10 Commercial Case Study - C2

Introduction

This case study consisted of visits, tours around the facility and interviews at a Wiltshire based third party managed composite distribution depot (sortation, consolidation and storage/warehousing roles) for its single client C1 - a major High Street multiple chain store. The depot operator and the client have had a business relationship for a long time - over 25 years. The depot handled boxed and hanging merchandise (37 million stock items, both 'live' and 'dead') which it prepared for onward transport to the 18 stores that it served in the south and south-west UK. The depot was 60m long, 40m high and had 54 aisles.

Case Study

The premises (depot/warehouse, grounds, etc.) were owned by the third party operator, but their contract with the client covered them if they ceased to work for him - should the client and themselves part company, then their client would buy the property, etc., or compensate them for any re-selling losses and associated expenses. However, the inventory handled and stored at the depot was owned by the client. In fact, the client conducted all the ordering of the material/merchandise that the depot received and this was circa £70 million per year - at wholesale value. The depot and the employees were 'customer' (i.e. stores and client) focussed. The composite distribution depot received supplies from about 200 manufacturers and suppliers in bulk, and these were credited into stock and picked/consolidated/consigned as requested by the 18 stores it served in the south and south-west UK via the Automatic Stock Replenishment (ASR) system - the depot received orders placed upon it from the stores on, or via, 'the screen'. All the software was supplied/lent (and owned) by their client which constituted a customised Multi-User Warehouse System (MUWS) and the ability to 'read-in/out' any barcoding system (a new, and Y2k compliant, software/system was going to be installed/inaugurated by the client soon). The whole depot operation was very labour intensive (particularly because of the individual item labelling that they did) and training was very important (particularly on-the-job (OTJ) training) for flexibility/versatility - there was no demarcation and graduated pay increases/rises were awarded for associated competence and versatility; but they really needed some form of 'Labour Management System'. The furthest store(s) that they serviced was/were about two hours away in delivery time (the client's policy for fashion items).

(The operator was aware that their client used other logistics service providers, and to some extent the client 'played one off against the other'. Comparisons were conducted, i.e. benchmarking of one operator with another, as well as against the client himself. The client owned/operated 18% of the depots being used himself, 44% of the depots were operated by this third party operator, and the other 44% were operated by another logistics service provider. Therefore, three sets of data were available for comparisons/benchmarking.)

The depot operator felt the power of their client in that there was constant pressure to continually drive costs down and improve quality/service in parallel. However, the client was tough, but fair, and payment was always received on time. Also, the rate that the operator received for the work was a little more than the normal going rate; the client was happy to pay this extra but expected quality, service, flexibility and efficiency. To this end the client shared all, and any, information (with confidentiality assurances of course) with the operator. (Apparently, contact by the operator with the suppliers and manufacturers found the same views and opinions by them too. In fact, the suppliers/manufacturers liked the arrangement with the client.)

A tour of the depot revealed good well thought out traffic flow management of the trucks/lorries both in-coming and out-going with the appropriate security procedures.

The author saw the operator's livery vehicles, the client's livery vehicles, and another third party operator's livery vehicles on the premises. These were either parked or docked at one of the bays. Material flow in the depot was well designed too, with essentially a 'one-way' flow arrangement (as the author's host stated: *"Layout is vital!"*). Merchandise would be off-loaded from the bulk deliveries: hanging goods were barcode 'read-in' and suspended on overhead conveyors with unique conveyor hanger indentity ('T' numbers); and boxed goods were placed on power roller conveyors which were adjustable to penetrate the lorries. Again the boxed goods would be barcode 'read-in'. The boxed goods and hanging garments would then be allocated a storage location and the automatic conveyors would carry these up to a mezzanine floor where the hanging goods were automatically taken to their allocated slots/places, and the boxes conveyed to one of various end points where a person would lift the boxes off and then take them to the alloted shelf/cage/rack. Large and heavy received pallets/boxes, after being barcode 'read-in', (some were pre-consigned for particular stores, these were just cross-docked to the appropriate store truck/consolidation), were left on the receiving bay floor. These boxes/pallets would be allocated a storage location and a fork-lift truck or hand operated pallet carrier would move them to the appropriate storage location on the same ground floor level. The depot was very clean and tidy.

Three call-offs per week from the stores (and hence three deliveries to the stores per week) was the norm. The call-offs were 'on-line', i.e. received via electronic link on 'the screen' on: Sunday; Tuesday; and Thursday. The biggest of these (50% of the weeks volume) was the Sunday call-off, basically this was the replenishment of the weekend's business/sales. The replenishment orders were on the screen at 05:00 am on each of those three days, but left open for up-dates and other additions (adjustments for local conditions/weather/speculations/opportunities, etc.) until 07:30 am which was the cut-off. This final replenishment screen listing for each store constituted the picking and consignment work for the depot. Around 50% of the picking would be carried out on the same day that the screen data was available and the balance would be picked the following day befor the lorry/truck left and would make the delivery. The depot claimed to have a 'pick accuracy/success' of 99.5% which they thought was good, given that every day and every week was different and that there was little, if any, consistency/constants.

Picking was according to the screen data per store. Items were picked and labelled/ticketed for the client/store (these could then be put straight upon the shelves in the stores, as their client's policy was that 'stores are for selling, not warehousing'). Palm-top/held computer key-pad/terminals with radio frequency transmission were used by the warehouse/store people. The author was told that with current software/computer system there was an element of 'double-keying'; however, with a new system that the client was supplying, this would be eliminated. Picked, labelled/ticketed items were then loaded into store departmentalised trolleys/cages and consolidated with the appropriate store's lorry, barcode 'read-out' and loaded onto the lorry. They tried to maximise vehicular space. All carton from unused boxes was flattened, collected and dispatched for recycling.

Some problems that they had were: theft/losses; salvage and damage; a double-keying issue on the computer system; truck utilisation - they claimed that their trucks were idle for 13 hours/day; a large volume/space was being used holding 'returned/unsold garments', awaiting for instructions from the client as to what to do with them? Some variables that came to light were: labour (peak time extras were from a local employment agent with whom they had a long time association), and consideration was being given to introducing a future work bonus scheme; and space utilisation.

Key performance indicators (KPIs) were: achieve budget and quality; picking accuracy/success; theft/losses; turnaround time (i.e. 'In and Out', the faster the better) on-time deliveries; single items picked; customer (i.e. store and/or client) complaints; stock

availability; and no carry-over. Some figures that were given: 74 000 single items picked in a year; 68 late deliveries out of 8 000 in 1995; and 59 complaints in 1995 - i.e. just over one per week.

The author had sight of various computer output charts, pie charts, histograms, graphs and tabulated data, but was not given the opportunity to inspect them closely.

Priorities are not encountered, they work to the computer system with its cut-offs. However, one interviewee manager recounted how once he was asked by an executive of the client at 16:30 pm to include an emergency order on a delivery the following day. The manager said he did it (manually - off the system - which they then corrected and/or adjusted later) purely to impress that executive. They could do it again, provided that they were real emergencies - after all, that is what flexibility, customer focus and service are about. The trouble with priorities, according to them, was that once it is known that they can be handled/carried out, the arrangement becomes abused. They felt that a consistent, disciplined, regular (and for the future to go to *daily* replenishments rather than the three times per week currently being worked), and systematic replenishment procedure(s) was the preferred solution.

All managers spoken to and interviewed, and many of the depot people, knew a lot about the client; they could quote characteristics and accurate statistics of the client and his business.

14.10.1 Data Sheet And Findings From Case Study C2:-

Goals/Objectives:

To constantly seek ways/practices to reduce costs including to be efficient (i.e. 'to do thing(s) right').
To constantly seek ways/practices to increase quality and service levels.
To be effective (i.e. 'to do the right thing(s)').
To be flexible.

Strategies:

Client (i.e. the C1 company) focussed and customer (i.e. the stores) focussed.
Cost focussed.
Quality focussed.
Service focussed.

Characteristics:

Products handled were non-perishable and all inventory is owned by the client.
Client dominates - the power is felt - BUT fairness prevailed - long standing association.
Client provides all and any information required/requested - communications are excellent.
Automatic Stock Replenishment (ASR) system - EPoS, computer triggered ordering and EDI.
Receives a higher fee (i.e. paid well and on-time) than from other clients - BUT - quality and efficiency is demanded/expected as well as flexibility and positive responses to change.
They know they are benchmarked with the client's and competitors' operations.
Various demand profiles and patterns are encountered: information comes through/via client's software.
The handling of 'hanging goods' is particularly very labour intensive.
Much computerised operational tabulated, graphed and histogrammed data.
The depot/facility was spotless - very clean and tidy.

Principles/Concepts:

Bespoke arrangement as defined by their client.
Consolidating and consigning mixed non-food goods per store.
Multi-User System (MUS) - real-time on-line computer system and software courtesy of the client.
Unique product coding and unique container coding.
Data capture system (i.e. barcode(s) reader) can read any/all barcode systems.
Call-offs received three times a week - Sunday, Tuesday and Thursday for deliveries to be made Monday, Wednesday and Friday respectively (i.e. next-day delivery).
Good warehouse/distribution centre layout for material flow and traffic flow purposes.
No demarcation, anyone can be asked to do anything. Carton recycling.
On the job (OTJ) training given and versatility is rewarded by an associated graduated increase in pay.
When/where necessary shared cabs/trailers with the client and the other operators that the client used.

Performance Indicators:

Turnround time - i.e. from receipt of homogeneous bulk to complete dispatch trailer of heterogeneous load per store (commonly known as the "IN/OUT" time).
Number of single items picked (e.g. 74 000 single items picked/year was the current rate).
Picked proportion - i.e. amount picked today for tomorrow's dispatching and the balance to be picked tomorrow.
Picking accuracy (e.g. 99.5% picking success was the current rate).
Space utilisation. Truck utilisation/idleness and vehicle space utilisation.
Losses/shrinkage and damages.
Late deliveries and complaints.
Training and staff versatility.
Percentage of 'live' items held - (non-selling/sold returned clothing no longer on offer were 'dead' items).

Dimensions:

Costs (£), Value of stock (£) and Time (hr).
Reach/Distance (km).
Number of line items (It).
Headcount (number of people).
Space: area (m^2) and cube (m^3).
Inventory age.
Quantity of stock (number of items at specific item level) - mainly items returned from stores and held awaiting instructions as to what to do with them.

14.11 Commercial Case Study - C3

Introduction

This case study consisted of visits, tours around the facility and interviews at a Berkshire based third party (the same parent company as case study C2) managed composite distribution depot (sortation and consolidation centre) for its single client C1 - a major High Street multiple chain store. The depot operator and the client have had a business relationship for a long time - over 25 years. The depot handled chilled and dry ambient foods which it prepared for onward transport to the C1 stores that it served in the south and south-west UK. The depot worked on a 24 hour per day (round the clock) basis.

Case Study

The premises (depot, grounds, etc.) were owned by the third party operator, but their contract with the client covered them if they ceased to work for him - should the client and themselves part company, then their client would buy the property, etc., or compensate them for any re-selling losses and associated expenses. However, the inventory handled and stored at the depot was owned by the client. In fact, the client conducted all the ordering of the chilled and dry ambient foods from the suppliers. On a normal week on week comparison the variation/difference in volume handled by the depot could be 20%; in a peak week, the volume handled could be 50% higher. An interesting fact was that in the two weeks surrounding Christmas, they handled the equivalent of two normal months volume. The client's ordering and store allocations were usually in the correct 'ball-park', certainly in the 'plus or minus' 10% region. The computer software and its architectural arrangements (EPoS; real-time; O-LAP; defined rules - very little, if any, judgement had to be used; throughout chain/network visibility; etc.) were supplied courtesy of the client. The procedure was to work according to the computer system, i.e. the data on the screen was their prompt/stimuli. They had a very good relationship with the client - information sharing, etc; - they were so close that they were effectively a part of the client - although the depot manager was not sure that *true* partnerships existed; he was of the opinion that one party always seeks to maximise his gain.

Deliveries to the stores had to be made outside of opening hours and within a 'delivery window' of 'plus or minus' 15 minutes (this is so that the food boxes/trays/packets are on the shelves before opening and available to the customers on entrance). Many stores received two deliveries per day; priority was given to the morning deliveries (i.e. fresh, chilled foods) and the second deliveries in the evening generally consisted of the dry ambient foods.

All in-coming (receiving) goods were barcode 'read-in'; most of the goods was broken-down, sorted and cross-docked to stores' consignments in the out-going/dispatching bays. The balance of goods left-over, if any, would be allocated a storage location and moved there to be stored - usually not for very long. The out-going goods would be barcode 'read-out' and loaded onto the appropriate allocated store lorries for transportation to the stores.

A tour around the plant showed good traffic layout/flow design around the depot and good layout for material flow inside the depot. The depot operation was very labour intensive and they were reviewing whether to introduce a bonus scheme - 'job and finish' was one scheme being considered. Received goods came in on pallets, in boxes and in cages (using container codes). The outgoing goods went out in wheeled coded cages that contained categorised food groups. The code reader and computer could accept any of the barcode systems in use. The plant was very clean and tidy. The chilled area was cold and people wore warm jackets and gloves. The author was shown the temperature recording meter that printed out a 24 hour gyro-chart. These records had to be kept and shown to

the client. A large number of empty cages was stored along side one wall in the ambient area; apparently these had 'wobbly' wheels and were awaiting a mass repair purge. Carton from boxes was flattened, collected and dispatched for recycling.

As they conducted all truck routine servicing themselves (particularly engine tuning - a 'Green' issue), a truck servicing and small repairs workshop/facility was on-site as well and it was in a spotless condition.

Peak time extra labour was hired from two local employment agencies.

Variables and performance indicators that were important consisted of: the manning sheet - their main measure; space and its utilisation; costs - a constant drive to reduce these; productivity - number of cartons per hour, the number in and out per hour, trays per lorry/vehicle; time compression is a constant pursuit; stock accuracy/discrepancy - they claimed a discrepancy as low as 0.0001%; picking accuracy currently at 99%; service criteria - would not elaborate; quality; temperature control of the chilled area; training; on-time deliveries; and accidents/safety. A comment was passed that there existed a volume/service trade-off given limited resources.

They knew/were aware that their client benchmarked them. This operator did an informal intuitive benchmark/comparison with their competitors via contacts at institutions, conferences, and details in the press/journals/related literature, etc.

Future aims were to effect change rather than to react and to become as close to being stockless as possible. They were in discussions/development phase with the client to introduce triple-compartmental vehicles, that is a lorry trailer that could carry three temperature zones - ambient, chilled and frozen, that would enable the whole food range to be delivered together instead of in their separate categories.

All managers spoken to and interviewed, and many of the depot people, knew a lot about the client, they could quote characteristics and accurate statistics of the client and his business.

An interesting detail was shared when the client was conducting a corporate hospitality occasion at a prestigious golfing tournament in Wales; the depot was asked to ensure that drinks and nibbles were always available - cost was not an issue.

The logistics type matrix was accepted with one comment that there would be smudges at the edges of the different types.

14.11.1 Data Sheet And Findings From Case Study C3:-

Goals/Objectives:

To provide a high service level.
To constantly seek ways of reducing costs and improving quality.
To constantly seek ways of achieving time compression.
To constantly pursue the aim of being stockless - i.e. to approach zero stock holding.
To move to triple compartment vehicles - frozen, chilled and ambient.

Strategies:

To effect CHANGE rather than to REACT.
Close to the client - effectively a part of the client.
Constantly seek how to add value for the client/customer?
The employment of appropriate new technology wherever possible if economically viable.
When/where appropriate to influence the client about new and better practices.

Characteristics:

25 year affiliation/relationship with the client.
Products handled were perishable.
Things change all the time, they are doing different practices today compared to a year ago.
The client provides all and any information/data requested and software supplied courtesy of the client.
Generally, standard products have stable demand pattern and are replenished; new products are unknowns but their client was usually within 10% of their forecast.
In the two week period surrounding Christmas - the volume handled equals two average months worth (i.e. a factor of 4-5 increase).
They know they are benchmarked with their client and the other operators that the client uses.
There was a service versus volume trade-off (given limited resources).
The operation was labour intensive.
The depot was very clean and tidy.

Principles/Concepts:

Because the client knows what he wants, it makes the service provider's job easier (bespoke arrangement).
Consolidating and consigning mixed single temperature food goods per store.
Daily 24 hour replenishment cycle.
Speed.
When/where necessary shared cabs/trailers with the client and other operators working for the client.
Very little use of judgement, the use of defined/established rules, (priority rules are system derived).
Totally IT/IS operated, real-time and the whole range of data capture.
The depot/distribution centre well designed for material flow and traffic flow.
Breaking of bulk to pack level - do not split below lowest packing level.
All deliveries to stores to be outside of the store opening times.
Training and education of the work force at all levels. Green issues: carton recycling and engine tuning.

Performance Indicators:

Various service criteria - would/could not elaborate. Training and staff versatility.
Manning sheets - this was the main measure, the basis for all subsequent productivity measures.
Temperature control of the various warehouse stockrooms - the daily temperature profile 24 hour-charts have to be kept and shown to the client.
Various productivity measures - like cartons/hour.
Cartons IN and OUT.
Picking accuracy and stock accuracy.
Trays/lorry.
On-time deliveries (within + or - 15 minutes).
Inventory accuracy.
Accidents and safety.

Dimensions:

Costs (£), and Time (hr).
Range/Reach/Distance/Sweep (km and km^2) also Space: area (m^2) and cube (m^3).
Number of line items (It).
Headcount (number of people).
Inventory value (£), inventory quantity (number of items at specific item level) and inventory age.

14.12 Commercial Case Study - C4

Introduction

This case study consisted of visits, tours around the facility and interviews at an Outer-London based third party managed composite distribution depot (sortation, consolidation and storage/warehousing roles) for its single client C1 - a major High Street multiple chain store. (This depot operator was a different parent company to the one that operated C2 and C3.) The depot handled hanging and boxed general merchandise for the London and suburban stores of C1. These serviced stores constituted the highest volume Sales of the client.

Case Study

This depot was owned by the logistics service provider, but there existed contractual obligations for their client to ensure they did not lose-out should their partnership dissolve. For this operator, supply chains were the management of suppliers, information, relationships and the stores. The information aspects incorporated its speed of transmission - the faster, the greater the power in the market place - 'real-time' item level detail, EPoS, EDI, and screen visibility throughout the chain/network were essential. The huge investment in software used here was provided courtesy of their client who owned it - this ensured compatibility, correct protocols and direct communication avenues/links with the client and his stores. (In the past they had 'islands of computer systems' which were now integrated and linked.) Whilst they operated a *paperless* organisation as far as possible internally, there was some way to go to achieve this paperless state externally. Also, in their daily replenishment role, they wanted to emulate the procedure of being a *fast-track cross-docking* operation (interestingly, they referred to this role as *secondary distribution*). Relationships, mainly with the client, but also with the suppliers, were important and these have been developed and nutured over many years. Thier client paid well, but demanded: cost reductions; speed (time compression); quality; flexibility; and service. As an illustration of what had been achieved they quoted: *"In the last seven years, while Sales have increased, the inventory stockholding has been halved and the throughput volume in the depot has increased three times."*

The transport costs incurred were less than 1% of Sales at retail value, considered well managed, and as such were treated as peripheral for cost saving opportunities - cost savings had to be sought elsewhere. They were cognizant of the fact that to increase their own turnover and profits, they had to seek value adding and service/servicing opportunities to offer their client.

The depot received merchandise from about 200 suppliers/manufacturers (including some from overseas). The goods received were ordered/purchased everyday electronically by the client. This, coupled with the operators daily deliveries, illustrated the mottos being used which were 'little and often' and 'bespoked and reliable'.

On tour around the depot (the depot was clean and tidy), the usual barcode 'reading-in' of received products and containers was observed. Goods were placed on coded conveyor hangers or roller conveyors and transported to either storage locations, or straight to the preparation area for labelling/ticketing, and then onto the allocated store consignment points on the dispatch bay side to marry-up with the picked ticketed/labelled and allocated items. The consignments would be cage/container departmentalised for the stores, be barcode 'read-out' and loaded onto the trucks. The processes were very labour intensive. Training was important and carried out (OTJ); the author saw the most impressive versatility chart he had ever seen, split between shifts and containing the trainers' names aside those they had trained and obviously, the individuals versus the job competencies, which were graded as 'some training', 'intermediate' or 'fully competent'. There was <u>no</u> 'bucking the system', the work was conducted according to the data on the

screen (although the author was informed that manual intervention was possible - but had never been used as it is frowned upon). There was an area of stored goods which were returned/unsold goods from the stores, awaiting instructions from the client as to what to do with them. Carton from boxes was flattened, collected and dispatched for recycling. The material flow design/layout was very good and logical.

In the truck receiving and dispatching yard, trucks of the operator's livery, the client's livery and another operator's livery were evident. The traffic one way system was logical, safe and efficient.

All managers spoken to and interviewed, and many of the depot people, knew a lot about the client; they could quote characteristics and accurate statistics of the client and his business.

The measures that were collected and managed included: headcount; manhours; productivity; quality; process time; picking accuracy; number of single items picked; transport fuel consumption; on time deliveries; and costs. Costs were being 'fragmented' in order to understand the details. Sight was had of much computerised produced charts, graphs and tabulated data but a close inspection was not allowed. They know that the client benchmarks them and they receive close attention from the client because of the volume that gets handled through the depot and its onward transportation to the prestigious/flagship stores.

For the near future, things that were in-hand were: better (millenium compliant) software and information sytem courtesy of the client which they are aiming to use for better ordering and receiving such that they could just do cross-docking; multi-store picking to be inaugurated instead of the single store picking and many revisits to the same bin/rack/shelf as at present; process time reduction/compression issues; further (higher level) automation introduction; to develop ways of handling complexities; possibly experimenting with mixed product deliveries - i.e. foods with non-foods; and further improvements of 'Green' issues/matters.

14.12.1 Data Sheet And Findings From Case Study C4:-

Goals/Objectives:

To be paperless.
To move away from 'islands of systems' to a 'fully linked/integrated system' - (just about there).
To be reliable.
To continue developing relationships with the client, the customers (the stores) and suppliers where possible.
To move from 'single store picking' to 'multi-store picking'.
To handle complexities and to install appropriate higher level automation.
To seek new/other services that can/could be carried-out for their client.

Strategies:

Viewed the supply chain/network as consisting of: SUPPLIERS; STORES; INFORMATION and RELATIONSHIPS.
Use of IT/IS and any new useful/helpful appropriate technology if economically viable/justified.
Huge investment in IT/IS - specifically to handle the DETAIL, but kept SIMPLE for the users.
They were in the secondary distribution business/area with their client.

Characteristics:

Software courtesy of the client.
Products handled were non-perishable.
Stores serviced were in and around London with the highest volume sales of the client.
Very labour intensive.
Much computerised operational tabulated, graphed and histogrammed data.
Transport cost alone was insignificant <1% of retail value - this was well tracked/documented and understood.
The depot/facility was spotless and tidy.

Principles/Concepts:

Bespoke arrangement as defined by their client.
Speed - fast tracking - electronic information transmission and data capture - (real-time data).
Cross-docking.
Consolidating and consigning mixed non-food goods per store (in single items if necessary).
Daily replenishment to stores - little and often - EPoS data at item level.
On the job (OTJ) training conducted and the author saw the best versatility chart of all that he had seen.
Carton recycling.

Performance Indicators:

Percentage of 'live' items held - (non-selling/sold returned clothing no longer on offer were 'dead' items).
Training and staff versatility - (the best/most comprehensive labour versatility/trained chart ever seen by the author).
Productivity - various.
Quality - various.
Cost/account ratios - various.
Number of single items picked.

Dimensions:

Costs (£).
Value (£) and quantity of inventory/stock - (stockholding value had halved in 7 years whilst volume throughput had increased by a factor of 3).
Inventory age.
Time (hr).
Number of line items (It) separated into 'live' and 'dead'.
Headcount (number of people) and manhours.
Distance/reach (km).
Space: area (m^2) and cube (m^3).

14.13 BhS/Mothercare/Exel Depot At Atherstone - Case Study - C5

Introduction

This case study consisted of a third party (i.e. Exel Logistics) managed national sortation and consolidation centre for British Home Stores (BhS) and Mothercare. The centre handled boxed and hanging merchandise/goods received from 140 suppliers and serviced/replenished/distributed to 270 stores. Whilst BhS and Mothercare stores sold foods too (BhS's annual revenues from its restaurants was circa £60 million and Mothercare baby food Sales was circa £12 million) these were not covered by this case study, although it was established that the whole category range of foods (i.e. frozen, chilled and ambient) were transported together.

Case Study

The site, property and facilities were owned by Storehouse (i.e. the holding company of BhS and Mothercare). From a group perspective, the combining of the BhS and Mothercare warehouses into this one centre was a great investment and cost saving by having one node instead of two and this was possible purely by the better material management and supply/distribution chain/network organisation and design. However the inventory it handled was owned by Exel. The arrangement was that Exel managed the whole inventory ordering, inventory management and replenishment to the stores, so Exel purchased the inventory from the suppliers with a 28 day payment period; it then replenished the stores and sold the inventory to BhS/Mothercare with a payment period of 14 days. They referred to this arrangement as being 'cash neutral', and in many cases, the merchandise was sold to the public before the supplier received any payment. (Cash neutral is a misnomer, it is really 'cash negative' with the supplier financing the inventory for a month.) In many cases the suppliers consigned store specific lots/loads - these were just cross-docked.

The demand patterns were such that Christmas was the largest sales period followed by Easter. Bank Holidays and the 'back to school' (i.e. late August/early September) period were peaks too, but of a smaller magnitude. There were also 'fashion fads' and weather associated 'blips' in demand. Obviously, in any given week, more goods were sold at the end of it rather than at the beginning, so the big replenishment role was replacing the goods/merchandise that were sold at weekends. The aim of the centre was to: minimise risks; maximise availability by fulfilling the stores' stock position; reduce lead-times; provide a service via adding value; minimise inventory; and reduce costs. Mainly, this was achieved by standardised systems and procedures which were measured and monitored, with everyone in the supply chain/network using compatible information systems, and having visibility of the same data, which was the stimulus for everyone. (Apparently, not too long ago, there used to be about 6 weeks inventory holding in the warehouse.) The principal KPIs were associated with service, promptness, availability, stockholding/inventory, productivity and costs - particularly trying to establish the logistics cost per item. This latter point was a issue where concern was displayed because they knew the 'in-take margin', but they did not know the logistics impact on this in-take margin.

Training and education of managers and the workforce in logistics was recognised as a benefit and an enabler. They wanted to generate a culture or atmosphere among the staff which was being 'customer obssessed'. Relationships were considered to be very important, to be open and honest, to know the people and partners with whom one was working, basically to minimise surprises. Having said this, there was no doubt that the client (BhS and Mothercare) had power over controlling the behaviour of the supply chain/network. Also, surprisingly, they revealed that not all of their suppliers had direct links/access to the sales data; this they claimed, was because of technical, and in some cases, trust, reasons. Ownership of the supply chain/network was not possessed by anyone in particular, but the ownership of information was an important issue.

Barcoding was used extensively; each item had a UPC and UCCs were used. These were scanned and 'read-in' on receipt, processed through the sortation centre (bulk-breaking, allocating, consigning and consolidating) to store-specific trucks, when they would be scanned 'read-out' and loaded. On-time delivery was a crucial performance factor and sometimes traffic jams and road conditions hindered performance.

Some day to day issues/concerns were budget differences and the impact on RoCE, cost per volume, the large number of points of contacts, product life cycles (PLC), product seasonality, service levels, physical resources, people - employees, vehicles, systems - computers, collection of carton for recycling, and space. For some reason, they made a point of telling the author that they did not use/employ direct product profit (DPP). They had a telesales link with the stores and had visibility of sales; they raised purchase orders on a daily basis to replenish the sales stock.

They claimed to have measures of everything and were looking at understanding the cost of service. Some evidence of this was forthcoming in the form of many computer generated tabulations, charts, histograms and graphs. Constant planning of physical aspects (resources) took place in all the time phases. They planned for change, and used Change Management to adapt to the business needs, always trying to match/balance the service to the cost constraints. Consideration was being given to the reality of the nation moving towards 7 days a week shopping. There was constant revision of data analysis to see how the supply chain time could be reduced and find the best ways/ideas to add value with a re-evaluation of the data distribution to each party as deemed necessary. Systems and data were key and crucial. Vehicle (truck/lorry) utilisation was not very high and to increase this they used some of their vehicles to collect loads from suppliers - a form of shared assets.

A tour around the plant was very interesting; it consisted of automatic conveyors for transporting boxes through the centre. The conveyor had individual coded plates upon which a box was placed with instructions of its destination; with automatic plate code readers strategically placed the boxes would be tipped onto other conveyor plates and/or just carried along until its destination was reached, when it would be tipped into a waiting cage or onto a feed conveyor for loading or further processing/work. The speed at which the boxes travelled was very fast. Hanging goods were suspended on individual coded conveyor hangers and transported to their destinations. (On one of the visit occasions there was a computer crash/problem and the overhead hanging conveyors were behaving erratically with sudden jerk 'starts and stops'. Many garments were thrown onto the floor by this movement/action.) The plant was not very clean or tidy and appeared to be constantly messy. In spite of the automation, the depot was still quite labour intensive.

Material flow layout/design was adequate in the areas where no automation existed and the traffic flow arrangement for lorries going around the buiding and for docking was fine and safe.

14.13.1 Data Sheet And Findings From Case Study C5:-

Goals/Objectives:

To seek cost reductions (to add value not costs) and to establish the logistics cost per garment/good.
To provide a high level of service.
To seek time compression.
To reduce stock - seeking to be stockless.
To successfully complete the combining/integrating of the Mothercare distribution facility into BhS site.
To minimise risks.

Strategies:

Knowledge of their partner/client - customer/client obsessed - (people of partners).
Use their own software - they want to own the information.
The use of appropriate new technologies (IT and automation) if economically viable/feasible.
Education of suppliers.
Have an open and honest relationship with client/customers and suppliers - minimise surprises.
Have managers who are educated in, and understand, logistics.

Characteristics:

The client (BhS and Mothercare) dominates - has power and control over the supply chain/network.
The site (fixed assets) were owned by Storehouse Group - owners of BhS and Mothercare.
Christmas and Easter were the big peaks (Christmas the biggest) - small peaks were Bank Holidays and late August/early September when children go back to school.
Replenishment needs were greater at the end of the week rather than early week - the weekend spend.
Much computerised operational tabulated, graphed and histogrammed data.
Whilst having an automated sortation facility, the site is still labour intensive.

Principles/Concepts:

Single national depot/sortation/composite/cross-docking centre for both BhS and Mothercare.
Inventory owned by themselves - the logistics service providers - i.e. Exel logistics.
Neutral cash flow arrangement - they pay suppliers in 28 days, their client pays them in 14 days; the difference is what finances the stock.
Standardised procedures and common IT/IS arrangements throughout the supply chain/network - multiple links - distribution of appropriate data to parties - electronic visibility.
Analysis and understanding of the possessed data to obtain true benefits, reduced time, add value and reduce costs.
Not all suppliers have direct link access to sales data - for technical and trust reasons.
Some consigning done for stores at the suppliers - cages/trolleys received allocated for stores.
Unique product and container barcoding used - full scanning equipment etc.
Daily - 24 hour - replenishment.
Communications, speed and relationships.
Training/education and versatility of employees. Carton recycling.

Performance Indicators:

Distribution costs as a % of Sales.
Product availability.
Fulfilment of store stock replenishments.
On-time deliveries.
Productivity; quality; costs; and service. Training/education and staff versatility.
Fleet utilisation (used for collections from suppliers too, i.e. shared cabs/trailer assets) and number of deliveries.
Intake margin is known, but the logistics impact on the intake margin is not known.
Picking accuracy, invoice accuracy and inventory accuracy.
Vehicle, vehicle space, and space utilisation.

Dimensions:

Costs (£).
Value (£) and volume/quantity of stock/inventory (number off of each item).
Time (hr).
Distance (km).
Headcount (number of people).
Space: area (m^2); and cube (m^3).

14.14 Levi Strauss Warehouse And Distribution Depot - Case Study - C6

Apparel Logistics/Distribution at Levi Strauss
Dates: Thursday, 20th. June 1996 and Wednesday, 2nd. September 1996

The depot at Northampton is the national distribution depot for the UK and all Levi products for Ireland pass through it too. The in-coming products came from their factories in Scotland, France and Spain; and they also received products made by third parties - generally these were in the south-east Europe region - (once, these products came in a lorry that also carried fish conjointly and all the garments smelled/reeked of fish, and therefore could not be sold). The depot holds circa 5-6 weeks of inventory (so they had an annual inventory turns of circa 9.5 times). Levi commenced an initiative on customer service 6-7 years ago. The reasons for the initiative were: their customers (the retailers) thought that Levi was brash and arrogant because of their strong brand; the retailers were constantly being let down; no partnerships were being developed; pilfering of their products whilst in/during transportation was rife; stock buffering started; the products were frequently oversold; and the above problems could not be solved in isolation. The recognition dawned that some 'image promoting' was necessary and the need to involve the retailer with this through to the consumer was identified, as some retailers would promote/offer other/competitor's products rather than Levi's because the relationship with, and reliability of, those competitors were better/preferred.

When Levi's products were first sold in the UK the arrangement was via an agent as a licensee. In addition to those retail customers, circa 7-8 years ago Levi decided to franchise as well. One of the principal reasons for this was to attempt to control the price competition of their own products and to halt some of the discounting practices [The author thinks this is something similar to the car maker BMW, whose policy with regard to its distributors is that they cannot compete with each other on product price; the product price is the same whichever distributor a potential purchaser visits.] They devised a plan to open 50 shops in a 5-10 year timeframe. So far they have opened 30 shops. It is a Levi policy to open shops in major cities/large population areas and in prime (High Street) site locations only (this prime site policy has been a constraint/limiting factor to the progress of the franchise scheme as such sites have not become available or been obtainable). There were circa 3 000 outlets in the UK that sold Levi products.

The whole quantity and style planning cycle started ahead of time: the author was cited the example that for the season November 1996 to May 1997 output requirements would be firmed-up in August 1996. This provided the data for the raw material procurement details and the formulation of the manufacturing master schedule. The blue denim material for Levi's well known blue jeans was manufactured by one supplier and Levi was the only customer - a monopsony. (An interviewee commented on the fact that the blue denim supplier could not provide enough of the material required (i.e. insufficient capacity) and he did not know why Levi had not bought-out the supplier and vertically integrated?) [The author wondered if this was the reason why Levi offered, and strongly promoted/marketed, the other denim colours of their jeans like black, tan, white, etc. in their shops, to slightly off-set the demand for blue?]

Their franchised shops were fitted with EPoS (but the supply chain was not electronically connected yet) and data collected from the past indicated that their annual sales volumes changed from month to month. Data was seen where sales in January (the lowest volume month in the calendar year) was set at 1 and the successive months were in factors of the January sales datum, i.e. 1.41 for February, 2.85 for September, 2.24 for November and 3.85 for December. The missed out intermediate months were factors ranging between 1 and 2; the quoted months of September, November and December were the big opportunities - i.e. peak sale months. Also, the data when analysed (plus some other market research) indicated that people bought (and owned) 4 times as many

'tops' as 'bottoms' - i.e. for every pair of jeans sold the purchaser, potentially, would buy 4 tops. From this analysis Levi changed the layout of their shops; originally the front part of the shops were decked out with the jeans (bottoms) and, the tops (T-shirts, shirts, polo shirts, blouses, etc.) were at the back of the shops. The layout of their shops/stores today is for the tops to be displayed at the front which helped with promoting/stimulating 'impulse purchases', and the bottoms are located at the rear of the shops. An added advantage found with this layout was that shop-lifting of jeans had reduced, probably because the potential shop-lifter had to penetrate the shop further/deeper now, he/she had to go to the back of the shop/store which meant a greater distance to exit, and may have acted as a deterrent. All garments are displayed folded on shelves; Levi believed this is what the consumers preferred and, this allowed goods to be boxed thus alleviating any goods on 'hangers' and the associated difficulties of transporting/handling of hanging goods. The retailers like the boxed method also, and they were the customers of the Northampton depot and always had the final say! It was recognised that the retailers held sway/power. Recycling of packaging was not carried-out at present but, recycling had been talked about and this was a project for the near future, and there existed a feeling that recycling may become a legal issue soon too.

Other data shown to the author was - the stock replenishment system - which consisted of the range of styles and sizes for each shop tabulated between a minimum and a maximum shop holding. The minima and maxima were stipulated by the shop management (the author was told that Levi purposely gave this power to the shop management; after all, they were responsible for the forecasting and quantities ordered from Northampton, the retailer called the shots). The ideal shop stock holding that all parties strive for is the mid-point between the maximum and the minimum and this measure is used as an informal performance indicator. The trading cycle for this replenishment system was weekly under normal circumstances, but went to twice weekly in the high volume months of September, November and December.

Two 'third party' carriers were used (Levi do not own any goods transportation vehicles themselves and this is in keeping with their policy of not having their branding/logo on the side of lorries/trucks - or boxes, all boxes are plain - they do not wish to inform on-lookers of the contents because of the high pilfering risk); one for the bulk deliveries to cities and the other for the non-city places. Levi now put a lot of effort into the relationship development with these two carriers and communicate their requirements so that these become well known. Better control now existed with regard to reliability and the pilfering/losses had substantially reduced.

Performance measures used were: cost/100 units; labour costs; non-labour costs; freight costs; % on time deliveries; % complete order; and various quality aspects.

Aspects of logistics for Levi for the future: balancing inventory to demand; removal of the inventory buffer/cushioning in the chain; contracting-out or obtaining consultancy help with their forecasting and the management of the forecasting; introduction of EDI; as the lease for the Northampton depot was coming to an end, looking for a new warehouse site and/or third party out-sourcing the warehouse management/operations; and the associated automation of the possible new warehouse. The author was informed that three years ago Levi had built a new automated warehouse in Germany, but the software has never worked. So this German warehouse is a 'white elephant' - it has been idle for three years - and as such there exists some scepticism about the automation matters? (Obviously, the matter is being pursued within the legal compass/domain.)

A tour around the warehouse was given to the author. Nearly all of the employees wore Levi products/clothes. The warehouse worked two shifts: a morning and an afternoon. The site employed circa 60 warehouse people and in the peak months temps were taken on for the necessary duration. Orders were received via telephone, fax or post,

the warehouse also ordered its requirements the same way. There were four receiving/unloading docks/bays. All in-coming goods were boxed (the boxes contained multiples of a specific garment style and size which were individually wrapped in a polythene bag and barcoded); and the boxes (i.e. containers) had barcoded labels. Once off loaded these boxes had the barcodes read and allocated a shelf location for storage in the warehouse. The boxes were handled/carried to the appropriate bulk storage shelving/racking and stored.

The boxes were picked out of the warehouse racking (or trailer standing in the car park) as needed and taken to the picking area. The picking area had inclined roller shelving (4 high) where the lower end had opened boxes of garments in size ascending sequence. Pickers who required items went to these boxes and selected the number of items for the order they were dealing with and packed (by 'store' boxing) the consolidated order for the retail customer. When the inclined roller box was empty, the box was discarded and the box behind it fell forward via gravity which was then opened and the work continued. A warehouse-person would then feed another box of the appropriate sized item from the back, i.e. the upper end of the inclined roller shelf, which would feed down in due course. This was a 'visual' picking replenishment arrangement and there existed a two flow speed layout. Between the picking area and the warehouse bulk storage there were two working areas, one for the fast moving items and the other for the slower moving items.

(A current project being conducted at the time was associated with the boxes being used for the in-coming goods. There were two problems with the current boxes: the 'footprint'; and they were difficult to handle - they had no 'hand-holes'. The 'footprint' (i.e. warehouse shelf/rack space consumption) dimensions of the boxes were not allowing an efficient usage of warehouse shelf/rack storage space and many boxes were being dropped as people handled them when manually moving them, or opening/removing the lids. A compatible footprint geometry had been established and the preferred location of hand-holes was identified. A number of trial boxes were being made for testing through the supply-chain and for eliciting comments/approval/disapproval from the other nodal members of the in-coming supply system.)

The pickers consolidated orders for the retail stores/shops and barcoded the boxes. These were then taken to one of the dispatching/loading bays via powered roller conveyors (the only automation seen in the warehouse) and placed with other consignments for the same vehicle. The whole operation was very labour intensive. The warehouse computer data was up-dated by overnight batch up-date, they did not have 'real-time' computing. There was no screen visibility of shop/store sales. A project existed to introduce EDI and other computer aids.

Material flow aspects had been thought through as the flow in the warehouse was logical and as far as possible was one-way/direction. The warehouse was fairly dirty and the floor was littered with much paper, packaging and label rubbish. The traffic flow arrangement outside of the warehouse and access to the unloading and loading bays for the lorries/trucks was not very spacious and congestion was observed. Also, many trailers were parked in the car park 'unhitched': these were being used as extra storage capacity. (As the lease for these premises was near ending, they were looking/seeking a new warehousing/premises which would permit more capacity.)

Levi is in the process of offering a 'tailored jeans' service (in central London stores only at first) and any customers taking up this opportunity will have their such items given a unique customer specific barcode for re-ordering purposes. This will define the product, provide customisation, speed-up the communication/ordering process and reduce manufacturing lead-times.

14.14.1 Data Sheet And Findings From Case Study C6:-

Goals/Objectives:

To improve customer service.
To offer a customised/tailored service for jeans to customers - individualised barcode.
To seek time compression opportunities.
To seek cost reduction opportunities.
To appropriately size boxes for rack storage foot-print (size and shape), ease of handling and for access/opening.
To balance inventory to demand were suuply exceeded demand - attempting to remove the cushion/buffer.
To open 50 new prime site outlets in a time-frame of 5-10 years (i.e. between 5 and 10 a year); currently at 30 in the time-frame (i.e. between 3 and 6 a year).
To move to electronic ordering.

Strategies:

No partnerships with 3rd. parties for warehouse/distribution centre management (i.e. owner managed).
Two carrier companies used for transport/freight - a relationship over many years with these two.
Relationship basis with retailers and factory suppliers.
Work one season ahead with their forecasting/planning; an outside agent was contracted to help with their forecasting.
Single sourced fabric producer for the denim (jeans) feedstock; producer could not supply the demand.

Characteristics:

Generally the principal product(s) were oversold - i.e. demand was higher than supply (due to a very long standing sole supplier's insufficient capacity problem/issue), but peak sales months were known.
Because of the strong branding - pilfering/shrinking risks were very high.
Power was with the retailers/franchisees.
Labour intensive.
EPoS was used in the shops/outlet but the warehouse was not connected to the system, so the shops placed orders on the warehouse based on weekly sales' replenishments required.

Principles/Concepts:

Unmarked (or no company 'brand' specific) lorries - not to advertise contents.
Unmarked/unlabelled boxes/packaging - not to advertise contents.
Own managed warehouse supplying own outlets and franchisees.
If priority was necessary (i.e. shortage of an item), then the largest volume moving outlet was ranked first irrespective of own outlet or franchisee; worked down in that manner. Allocation was not used.
Barcoding - unique product (even tailored customer specific jeans) and unique box/container coding.
Shop layouts were changed as a result on analysing EPoS data.

Performance Indicators:

Average number of items picked per person per day.
Cost per 100 units.
Percentage of on-time deliveries.
Inventory accuracy and pick accuracy.
Order fulfilment and Service.
Training and staff versatility.
Damages/losses and Quality.
Mid-point stock holding at the shops/stores. (Would like to measure lost sales/opportunities.)

Dimensions:

Costs (£) - labour, non-labour and transport/freight.
Time (hr).
Space: area (m^2) (e.g. 'footprint' of boxes) and cube (m^3).
Distance (km).
Inventory/stock value (£) and quantity (number off of each item and by size).
Headcount (number of people).

14.15 Commercial Case Study - C7

Introduction

This case study was a third party managed logistics warehouse, consolidation and composite distribution centre for a High Street multiple retail store handling frozen, chilled and ambient foods and covered the south and south-west UK. The retail store (a different one to C1) had over 750 stores nationwide, and the third party operator was, again, a different one to any of those employed in the above case study scenarios.

Case Study

This depot, property, facilities - including the computer software, and the inventory handled belonged to the multiple retail store (except the cabs and trailers, i.e. lorries/trucks). The current software was not millenium compliant, but the owner/client was developing a new and more sophisticated software which was soon to be introduced, it was millenium compliant and was more 'agile' in terms of being able to inprove the operations. The service provider solely managed the operation and received a management fee for so doing; there was an open book accounting policy in tow. The multiple retailer owned and operated his own composite distribution centre in the north-west UK for servicing his northern stores. The operator here knew that he was constantly being benchmarked with his client's operations methods, costs, productivity and service. The volume split of food categories handled was: Frozen 46.0%; Ambient 40.5%; and chilled 13.5%. Of course these goods were perishable and a vigilant FIFO sytem was adhered to rigorously.

The site was originally operated and managed by the owner who then changed his policy and decided that this operation should be outsourced. The third party operator had been in place for some two years and for most of that time they had a client's manager or representative permanently on site to advise them as well as to monitor them and report as necessary to the owner. This was a kind of 'association period of adjustment'. The current operator was pleased that the owner's 'spy' was no longer a permanent feature, and this was an indication that they were now trusted, considered competent, reliable enough and empowered by the client to 'act alone'. An immediate comment conveyed to the author was that almost everything this operator did was governed by data, information and relationships. Good relationships were very important and the operator was aware that his client was considering the possible introduction of 'home deliveries' for his customers; this operator saw an opportunity to tender for and acquire that work.

The operator was charged with seeking: lowest cost solutions; the highest service levels; short lead-time ordering; and to develop and move towards multi-compartmentalised vehicles so that the whole range of foods could be delivered to stores with one 'drop'. For their side, the operator pursues being professional, open and honest, accountable and provide good communications.

Big demand periods were Christmas and Easter, but the Christmas demand spanned a longer time. Other lower peak demands were experienced like seasonality and weather related aspects, but particularly when the client offered what was referred to as *"Give away offers!"* - These were colloquially known as BOGOFs, i.e. Buy One, Get One Free!

Until the recent present, the depot received orders which were formulated/forecasted by each store manager and at that time the client was considered to be a *"... knee jerk operator!"* This has now ceased and each store's EPoS data was utilised whereby the depot received what is called 'sales based orders' (SBO).

Many aspects/things were measured and monitored, the author was shown a weekly report which consisted of many computer produced charts, graphs, histograms and

various tabulations of data. The lowest item level of goods for the depot was the case/box. There was no breaking-down of bulk further than a case/box and almost all productivity and cost measures/ratios were in relation to the case/box. Reports were issued weekly, monthly, quarterly and annually, with present performance cumulatives for the period to date, and the variances highlighted.

A tour around the facility revealed that each food category was a separate section, i.e. frozen; chilled; and ambient - this was like warehouses/depots within a warehouse/depot. However, the procedure was the same for each category. The frozen and the chilled areas were temperature controlled and 24 hour temperature gyro-charts per day were recorded and kept for each zone. Layouts were very good in all aspects. All received bulk/pallets etc. were barcode 'read-in' and these were allocated storage locations and moved to those positions. Handling was primarily with fork-lift trucks. Pickers, working from the screen would pick the appropriate number of cases of the various products per store and consolidate and consign for each store. Pallets would be ascribed a unique container code, 'read-out' and loaded onto the right lorry for transport to the store. Orders and deliveries were on a daily basis, i.e. every 24 hours. Carton was collected, flattened and sent off for recycling.

In the truck/lorry park both the operator's livery and the owner's livery were evident, and shared vehicles was a common practice.

14.15.1 Data Sheet And Findings From Case Study C7:-

Goals/Objectives:

To be empowered - by their customer/client.
Lowest cost solution sought.
To achieve highest service.
To move to short-lead ordering.
To develop and move towards multi-compartmentalised (i.e. various temperature zoned) vehicles.

Strategies:

Professional, open, accountable and communicative.
Customer, cost and service focused.
The establishment of a relationship basis with their client.

Characteristics:

Software courtesy of the client.
Products handled were perishable.
Received a fixed management fee.
Open book account.
Assets owned by client - fixed (excluding cabs/trailers) and current (i.e. inventory).
They know they are benchmarked with client's operations.
Christmas (the longest) and Easter were the peak demands; give away offers, seasonality/weather peaks.
Much computerised operational tabulated, graphed and histogrammed data - daily, weekly, monthly and quarterly.

Principles/Concepts:

Composite/transshipment/cross-docking distribution and storage/warehouse centre.
Nodes (with defined functions/responsibilities) and links.
Sales Based Ordering (SBO), i.e. replenishment - once/day.
Speed, time compression. Case (SKU) and container level tracking - using barcoding.
Where/when necessary shared cabs/trailers - assets sharing.
Carton recycling.
Good warehouse/distribution centre layout for material flow and traffic flow purposes.

Performance Indicators:

Cases picked/shift. Pick accuracy/person.
Cost/case standard cost comparison allocated to sections (variances, etc.).
Number of full replenished pallets.
Number of failed replenished pallets.
Stock corruptions.
Losses/damages - by case(s) and value (£).
Number of late departures of lorries/shift.
Vehicle utilisation: runs; drops; distances; durations; and delivery performance.
Temperature control of the frozen and chilled zones.
Training and staff versatility.

Dimensions:

Headcount (number of people) in different sections e.g. Warehouse; Transport; and Clerical & Management.
Area (m^2) categorised into Frozen; Ambient; Chilled; and Warm - although just used for extra storage.
Cube (m^3).
Number of line items (It).
Cases (i.e. a box or a packet/package of a set number of items) - they did not breakdown to single items, the case was the lowest item level they handled.
Inventory age.
Time (hr).
Distance (km). Costs (£).

14.16 British Steel Service Depot - Colnbrook - Case Study - C8

The Colnbrook depot was a Steel Merchant which was acquired by British Steel (BS) some 12 years ago. BS is the 3rd largest steel producer in the world employing 42 200 people worldwide. The company has been reorganised twice in the last 10-11 years. Colnbrook Service Centre employs 57 people (they kept the best when they reduced from 202 about 5 years ago). The Centre acquires 6 types of steel strip of varying gauges (thicknesses) and cuts the steel strip to size for its customers, who are primarily the domestic and automotive factors of production markets (multiproduct requirements are catered for thus allowing their customers the 'one stop shopping' concept). The Centre's throughput amounts to about 1 700 tons/man/year.

The company has changed over the last circa 6 years following principles of: greater customer focus; fewer lines of communications; lower cost structure; competitive commercial transport; the benchmarking of best practices; and continuous and never ending improvements (CANEI). The Colnbrook Centre has embraced all these principles. All these are backed-up with training for their personnel; they see training as being key to their improvement.

The type/nature of business the Centre handles falls into three categories: contracts; semi contracts; and spot business. These are handled through their Account Managers who are trained in and possess the product knowledge. Their belief is that they have 3 types of customers: order givers; delegators; and partners. Orders are received via mail, faxes, telephone calls backed-up by faxes and pre-planned 'call-offs' from their partners. They did see EDI as a future possibility.

The Centre's role has changed/moved from being a 'bulk-breaker' to providing service and quality via customer analysis and a scope exercise; this is a response resulting from much 'product dumping' of steel from Iran, Spain (Bilbao) and East Europe. British Steel's General Manager (Europe), Mr. Richard Barber said last month (April 1996): "... because product quality and price are not sources of long term sustainable advantage, it follows that the key differentiating factor on which we must focus, is Service in all aspects." The Centre is looking at ways it can be more creative with its service by going from its present delivery of 48 hours (from order receipt to customer receiving) to 24 hours and then approaching the 12 hour cycle. These improvements are sought via information collecting & storing as well as overhauling their administrative processes. The biggest quality problem they have is allocating the wrong gauge size - they say this is purely an administrative issue. The other quality problems (ranked) are associated with: over deliveries; price errors; various other complaints. Another creative ploy seen to supply/distribute to smaller customers is the concept of "Steel Shops".

Cost reductions are sought - particularly overheads; in the recent past they have conducted an Activity Based Costing (ABC) exercise - which paid-off handsomely; they were very pleased with the gains. They do not at present reclaim/recycle packaging but they realise that this will be a big environmental issue for the future and they are beginning to learn about it and to investigate what/how they can play their part and the benefits that can be accrued. Their principal packaging materials are woven polymeric sheeting/cloth/wrapping and timber in the form of pallets/wedges/spacers.

The Colnbrook depot claimed to operate the cheapest transport costs within BS; this is because they have the flexibility of their long past and fruitful relationships with owner/driver truckers. These owner/driver truckers (which were inherited by BS when they bought out this small steel merchant 12 years ago) not only supply the flexibility that Colnbrook seek but they take excellent care of their trucks by keeping them clean and pristine as well as having very good driver presentation; Colnbrook see this as an added advantage in that their products are delivered in a livery/fleet of very good appearance and

driver presentation. Attempts are always made to load the lorries up to the maximum weight (for best utilisation of load) and routing such that more than one delivery (drop) per journey can be achieved; also, if possible, to find loads for the transport to return with, i.e. picking-up rolled sheet steel from their mills in south Wales. Colnbrook are very concerned because they have achieved the lowest transport cost within BS who had originally allowed each depot to manage/arrange its own transport; however the BS policy for transportation is beginning to change, with the intention of contracting out the whole of the corporate transportation to Exel Logistics. This will result in total transport cost reduction for BS, but increased depot transportation costs for Colnbrook Service Centre; the Centre is also a little concerned that it may lose the flexibility that it now possesses.

I was then given a tour around the Centre commencing in the sheet steel roll storage area. Here was where they received and stored the different types of sheet steel rolls. The rolls were stored upon wooden packing and wedged on the ground. Steel rolls were stored together in their generic groups; all the plain carbon sheet steel together; all the stainless steel sheet together; all the galvanised coated steel sheet together; all the cladded sheet steel together; etc. The gauge sizes (thicknesses) were not segregated to a specific extent although I was told they try to keep the same gauges (within the generic type) together as far as possible without constantly rehandling the material to achieve it. Most of the sheet steel rolls came from their steel mills in south Wales (there was an odd exception). All the unused rolls were covered in woven polymeric sheeting and then secondary-wrapped in shrink wrap. On the shrink wrap was a large white label with all the details of the roll and a barcode. It was obvious that the steel mill supplier uses barcoding of its product output, but the Centre did not operate using the barcoding facility, they did not have the equipment to do so. However, I was told that eventually they would be using the barcoding facility. (I thought this may help reduce the wrong gauge problem that was so prevalent.) The warehouse had an overhead bridge crane which ran the whole length of the building. In the centre of the roadside length wall was a very large entrance/exit aperture where the lorries backed-in to unload and through which the local forklift trucks ferried the rolls to the cutting shop across the road.

Leaving the feed material storage area, we crossed the road and entered the cutting shop. In here the sheet steel was loaded onto Italian made and supplied slitting and guillotining machines. The cutting shop was an L-shaped floor building consisting of two slitting machines and two guillotines. The material flow through the shop was quite logical in that the 'raw' material came in at the foot of the L and the processed and packaged material exited from the head of the L; the material flowed in one direction only. All machines were working except one of the guillotines. Interestingly, the two slitting machines in operation had other set-up mandrels/arbors with spaced slitting wheels ready for the next operation on the machine, thus reducing the set-up time delay to increase the machines' earning utilisation.

On entering the loading area all of the lorries parked there were very clean and all chrome parts were gleaming; all the different trucks in the fleet did look immaculate and they seemed brand new; many of the vehicles appeared to have personalised number plates or some relevant alpha-numeric string registration.

14.16.1 Data Sheet And Findings From Case Study C8:-

Goals/Objectives:

To achieve/attain a lower/cheaper cost structure - e.g. overhead reduction; process(es) cost reduction.
To be flexible.
To incorporate raw material barcoding arrangement into normal operational practice of the centre.
To instigate EDI information/trading with all customers and suppliers.
To be fast/quick/rapid/speedy; time compression of period from receipt of order to dispatching.
To understand their customers and to develop long-lasting relationships.
To seek 'creative service' opportunities.

Strategies:

Greater customer focus - with particular regard to service and relationships.
Fewer lines of communications.
Cost and service focus.
Benchmarking for best practice - CANEI - Continuous And Never Ending Improvement.
Change ingrained in people - restructured/reorganised twice in five years.
Knowledgeable workforce - training/education as and when necessary.

Characteristics:

Supply multi-product requirements to domestic appliance and automotive markets.
Business consists of three type: 'contracts'; 'semi-contracts'; and 'spot'.
Three types of customers exist for them: the partner; the delegator; and the order giver.
Biggest quality problem is allocation of the 'wrong gauge' sheet material - purely an admin. issue.
Transport achieved with owner/driver truckers - very competitive transport is achieved and excellent service coupled with delivery/driver appearance/presentation.
Must be competitive because of much cheap sheet-steel product dumping from: Iran; Eastern Europe; and Spain (i.e. Bilbao).

Principles/Concepts:

Moved from 'bulk-breakers' to quality and service providers.
Added value and/or 'form' postponement.
Customer analysis - scope exercise.
Parallel processing of setting-up next cutting mandrel/arbor whilst current run is in operation.
Establishment of customer account managers with product knowledge.
Steel service centre concept; looking at "Steel-Shops" as a new concept to serve smaller customers.
Activity Based Costing (ABC) exercise - which has paid-off.
Packaging - both disposal and recycling; realised that the environmental issues were big for future.
Winning employees commitment to the customer service principle/concept/practice.

Performance Indicators:

Turnround time.
Weight of material: sold; scrapped.
Quality: the correct specification (i.e. gauge - the biggest problem, type and cut sizes) of material; order fulfilment (particularly over-deliveries - because of 'call-offs'); price errors; and complaints.
Costs: critically analysed into labour, materials, overheads and administration & general.
Costs of: operation; scrap and quality; and of customer dissatisfaction.
Inventory accuracy.
Productivity and output (tonne/head) e.g. 1 700 tonne/head/year. Training and staff versatility.
Correct delivery address and delivered to the right customer(s).
Accidents and injuries.

Dimensions:

Costs (£); Time (hr); and Weight (kg and tonne).
Inventory: value (£) and amount (i.e. weight (kg and tonne) and length (m) of a set width (m) reel/coil).
Headcount (number of people); and Distance: reach and range (km).
Space: area (m^2) and cube (m^3).

14.17 Nationwide Postal And Distribution Depot - Case Study - C9

The Nationwide distribution depot at Swindon is the centralised location that:-
1) prints and delivers custom stationery
2) stores circa 3 000 items for Head/Regional-Offices and the Branches
3) is the 'hub and spoke' for all in-house national post, viz:-
   i) picks-up all national in-house post, pass-books, documents & cheques
   ii) sorts-out the received/incoming 'post, etc.' for the appropriate destinations
   iii) delivers the 'post etc.' to the Branches and Head/Regional-Offices.

When the depot was first set-up (circa 11 years ago): it was one of four depots/warehouses; it owned and operated a fleet of 11 vehicles and 12 drivers. The management believed that due to their lack of experience they pursued a management route/philosophy that was carried on everywhere else at that time: 2-3 regional warehouses; huge stocks held everywhere; monthly supplies and deliveries; and a high permanent headcount. About 7-8 years ago, senior management began asking questions about, and quizzing the costs of the distribution facility and the service being offered. It was this cost and service focus that prompted the depot to change it's ways; and this cost and service basis approach continues to be the first consideration of everything that they currently do/perform. They used 'supermarket' principles/practices in the logistics and design aspects of the depot and its role.

The questions that were asked centred around: 'what do our branches and offices expect, or would like?', 'what are the best practice ways of doing what we do?', 'the time of when to move items?', 'how to move items?', 'what ways could these be achieved?' and 'could money be saved in implementing such changes?' The first studies/analyses were conducted along the lines of using Supermarket distribution concepts.

Now, the depot's operations have significantly changed: it is the only centralised depot; it has only 3 drivers; owns no vehicles; all the transportation is outsourced and the local vehicles used are hired/rented; and they operate with the minimum of permanent headcount which is about a third of the past numbers. During times of high activity, i.e. when a new product is launched or seasonal high demands, temporary staff are employed (or topped-up) to cope with these peak activity levels. These temporary staff are taken-on from 3 staff agencies with whom Nationwide has formed a good long-standing relationship, which generally results in the same good people being sent. These people have been trained by Nationwide previously and know most of the job requirements/details as well as knowing the permanent staff. Both the inventory and purchasing have been Pareto analysed and they now have a budget and tight management focus on the top ten items in each.

The depot picks-up and delivers daily to every branch/office throughout the UK via a third-party transporter. It has, and achieves, a 24 hour turnaround service from receiving stationery orders and the mail. Each branch has an allocated tote box with its own unique barcode. When the tote boxes have been picked-up and brought to Swindon, they are barcode 'read-in', the contents are removed, sorted and replaced in the appropriate tote box to which each mail item is addressed. The tote boxes are also filled with any stationery and printing that was requested by each branch. The tote boxes are finally barcode 'read-out' and loaded onto the appropriate lorry for delivery to the branches.

The depot is developing the ability to conduct purchasing via EDI and then to set-up EDI links with the branches for re-ordering to be achieved 'screen to screen'. If a priority order arises (not very often), it comes via telephone and is handled manually. Customer Pass Books are barcoded with a unique customer code. The printing presses used 'outside setting-up' whilst other jobs are running. Also, the storage and record keeping of some partly used limited life computer components are part of their function.

14.17.1 Data Sheet And Findings From Case Study C9:-

Goals/Objectives:

To reduce costs.
To improve service.
To minimise staff numbers.
To pursue time compression methods/processes.
To minimise inventories.
To manage the business/process such that an evenness (i.e. steady-state) in demand/supply results.
To reduce set-up times on the printing machines/presses.
To outsource any non-core activities/processes (e.g. have moved away from owning 11 vehicles and having 12 drivers to 3 drivers and two vans. Transport has been outsourced and extra vehicles are rented on an 'as needed' basis).
To install/commission EDI stationery ordering from Branches.

Strategies:

Focus on costs (and efficiency) is the first consideration.
Focus on service.
Focus on process changes that will reduce the headcount (a change culture environment).
Educated and trained workforce is a way to achieve the above three.
Open-book policy.

Characteristics:

The Branches are the customers and they weild power.
3 000 items in the warehouse.
Surges when they launch a new product/instrument (notification/posters/PoS marketing leaflets, detail dissemination, account and pass books, meeting legal requirements, etc.).
Small surge at Christmas/New Year - cards/new diaries/calendars and associated stationery; also when a new Branch is opened.
Usually, many changes occur during the launches - these result in cost increases.
No shelf-life issues - but obviously deleted product/instrument stationery obsolescence - not a large concern/problem.

Principles/Concepts:

Always asking the question of when (i.e. the right time) and how?
Maintains an interest in observing/watching and understanding how other logistics operators conduct their processes/purposes and trying to draw parallels and learn lessons for themselves (not afraid to copy).
Benchmarking is used but not in an official/formal sense - more by observed/informal comparison.
Attempted to achieve a steady-state (i.e. demand/supply smoothing).
Sharing of information and developing relationships.
Inventory analysis.
This was a national warehouse/depot/mail-hub (i.e. a 'hub & spoke' concept).
Sortation of mail and cheques (down-loading also).
Daily round of delivery and pick-up (i.e. 24 hour repetitive system - a daily service).
Unique container (re-usable Branch tote box) codes (i.e. barcodes).
Barcoded account/pass books for clients.
Purchasing follows re-order point concept for most items, some items are on a lead-time basis.
Any priorities are telephoned-in and are handled as an urgent request (not common).

Performance Indicators:

Consumption rates and dating recording of some 'life-limited' computer components.
Number of items picked per hour.
Number of orders received; number of items per order; and fulfilment rate.
Inventory/stock value and quantity.
Number of errors.
Availability - target 97%.

Dimensions:

Costs (£); and Time (hr).
Headcount (number of people).
Distance: reach and range (km).
Space: area (m^2); and cube (m^3). Inventory: amount/quantity (kg and number off); and value (£).

"What we call the beginning is often the end
And to make an end is to make a beginning.
The end is where we start from."

Thomas Stearns Eliot (1888-1965), *Four Quartets* 'Little Gidding' (1942) pt. 5