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"A framework to relate business improvement actions and performance measurement"

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Abstract

This thesis reports on the development of a performance improvement framework that formally represents causal relationships between performance measures, factors of performance, improvement actions and the overall strategy of a business.

The measurement of business performance has received significant attention from both the academic and business worlds. Literature suggests the benefits of implementing balanced performance measurement. However, practitioners in the field of performance measurement do not seem to deliver the significant results anticipated by the research community.

The research reported in this thesis delivers a performance improvement framework that allows practitioners to integrate the operations knowledge in an organisation with a formal performance measurement system, in the form of causal relationships in improvement actions. This gives an improvement focus to measurement and at the same time ensures that improvement actions are aligned to the overall strategy of the organisation.

The development of the framework was based on methodological theory development and empirical case studies. The process to apply the framework and a set of web-based tools to support its implementation were also built. These were tested in a process industry environment.

The research contributes to knowledge by extending the concept of performance indicators to incorporate factors that affect them, the potential improvement actions, their constraints and their relationships. For organisations that have established performance measurement systems and are working with a performance measurement culture, use of this framework allows them to systematically evaluate actions for continuous improvement.

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GLOSSARY OF TERMS

ABC	Activity Based Costing
AHP	Analytical Hierarchy Process
BPR	Business Process Re-engineering
CI	Continuous Improvement
Competitive Priorities	Dimensions of performance on which an organisation competes in its target markets. They can be generically defined in terms of Quality, Cost, Delivery and Flexibility
ERP	Enterprise Resource Planning
FMS	Flexible Manufacturing Systems
JIT	Just In Time
MPC	Manufacturing Planning and Control
MRP	Materials Requirement Planning
Performance Indicator or Performance Measure	A metric used to quantify the efficiency and effectiveness of action
PMS	Performance Measurement System
QFD	Quality Function Deployment
QMPMS	Quantitative Model for Performance Measurement Systems
SPC	Statistical Process Control
TQM	Total Quality Management
WCM	World Class Manufacturing

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Chapter 1 – Introduction

1.1 Background

Managers need to make decisions to improve the operational effectiveness of their organisation. Most of these decisions are based on a combination of their experience and judgment. In many cases, the information and knowledge about the operations of the organisation exist in various parts of the organisation but are not systematically used to support improvement decisions. This thesis proposes a framework and associated tools to harness this knowledge in the form of causal links within a business performance measurement system.

A business performance measurement system is defined as the set of metrics used to quantify efficiency and effectiveness. Research in performance measurement system design and implementation reflects the rethinking in the way that businesses ought to measure and manage their performance (Andersson et al., 1989; Eccles, 1991; Kaplan and Norton, 1992). Traditional financially oriented measures were inadequate in conveying the long-term strategies that were needed by customer-oriented markets (Johnson and Kaplan, 1987). Organisations realised the importance of managing their performance in more effective and accurate ways, and consequently the importance of aligning their performance measures to their strategy. Several performance measurement frameworks such as the Balanced Scorecard (Kaplan and Norton, 1992) and the EFQM (European Foundation for Quality Management) Excellence Model (EFQM, 2000) emerged in an attempt to address this issue by incorporating more than just financial measures and viewing business performance through multiple perspectives. The theory in the field of performance measurement systems has been well explored and various approaches have been developed. However, the practical implementation of such approaches is limited compared to the volume of theoretical development.

This rethinking in business performance had a major impact on the traditional concept of performance improvement. When an organisation has a well-established performance measurement system, this provides an opportunity for the improvement process to be aligned to the overall direction of the business, as expressed in the performance

measurement system. Performance measures include not only external drivers such as customer requirements and market orientation, but also internal parameters such as efficiency and effectiveness, which justify any improvement actions. A deep understanding of these drivers and parameters is fundamental if the performance measurement system is to lead organisations to meet their strategic objectives.

1.2 Performance Improvement Problem

Investigation in the field of performance improvement (Fry, 1989; Kennerley et al., 1996) suggests that performance improvement on a localised basis can lead to sub-optimum improvement and deviation from the organisational strategy. This deviation is caused by the situation where companies seek improvement by taking actions without examining their full impact on the overall strategy of the organisation. This can lead to actions conflicting with higher-level business objectives, and the possibility of having improvement in one area and performance deterioration in another. Sub-optimisation of performance improvement does little good to the positioning of a business. Consequently, companies are faced with the problem of achieving high level of performance in key areas, and at the same time balancing the trade-offs that inevitably exist between them (Maylor, 1995). These trade-offs are an area where companies need to achieve more informed and balanced decisions regarding the management of performance improvement. These observations apply in organisations of any size and sector.

1.3 Current State of Research

Research in the use of performance measurement systems to achieve business improvements has mainly focused on the use of appropriate measures (Azzone et al., 1991; Neely et al., 1995). Approaches such as the Balanced Scorecard and the Performance Pyramid are proposed for managing performance, but the majority of these approaches do not inherently help management to identify specific actions that can improve measurement results. Current literature does not fully consider the operational knowledge in an organisation when initiating performance improvement.

1.4 Thesis Problem

The structured management of the performance improvement process requires the understanding of the factors that affect performance and their interactions and also the operational constraints that limit the improvement. This knowledge forms the basis on which effective performance improvement can be planned. When attempting to improve performance in one of the areas of an organisation, there is the need to consider the impact of the intended actions onto the other areas of the organisation. Furthermore, when taking improvement actions, it must be done in a way that takes into account operating constraints such as the resources required to take these actions. This improvement knowledge exists in different fragments within the organisation but is seldom used formally by decision makers

To successfully integrate the operational knowledge present in a performance measurement system, and represent adequately the complex relationships between its elements, one must also consider the usability and practicality of such an approach. This thesis proposes a structured framework that represents this knowledge and provides the foundation for delivering effective performance improvement that will steer the organisation towards its strategic objectives in a way that is useable. This is in contrast to the bottom up improvement initiatives that rely on management 'feeling' to coordinate. The framework offers the structured information model to extend the capability of hierarchical performance management systems to capture and maintain the cause and effect relationships of improvement actions.

Within the resources available in this project the work is developed and tested in a process industry environment.

1.5 Research Objective

The research objective is to develop a framework to allow manufacturing organisations to identify performance improvement actions, which are in alignment with organisational strategy within their already existing performance measurement system. This is performed in the context of a make-to-stock environment, in a market which is characterised by relatively stable demand with small seasonal variations in the process industry.

For organisations that have a strategically aligned performance measurement system, and are working with a performance measurement culture, the performance improvement framework adds value as a tool for continuous improvement.

1.6 Research Outline

Initial investigation in the application of performance measurement indicated that:

1. There can be a finite number of factors that affect a performance indicator. When attempting to alter the performance of an indicator we are essentially attempting to alter one or more of the factors affecting it (Bititci, 1995; Suwignjo et al., 2000).

2. Understanding the factors that affect different measures of performance allows their manipulation in order to enhance future performance (Bititci, 1995; Brown, 1996; Kennerley et al., 1996; Suwignjo et al., 1997).

3. Effective performance measurement, based on financial and operational performance measures, can contribute to improving an organisation's performance (Neely et al., 1995; Lingle, 1996).

4. The quality of the information within a well-designed performance measurement system is good enough to allow the existence of explicit vertical links between different performance indicators.

5. Information regarding the resources needed to carry out a performance improvement initiative could be made available within an organisation through the existing measurement procedures of a performance measurement system.

1.7 Research Methodology

The overall research objective is to be built up the research results from several research activities:

1. Establish the characteristics of a 'well' designed performance indicator and performance measurement system.

2. Achieve a better understanding of the relationships between performance indicators and the factors that affect them at different levels of a business.

3. Understand the impact of improvement actions on the overall business performance and the requirements for initiating such actions.

4. Develop and validate a framework for initiating performance improvement in accordance with the business strategy and operational circumstances.

5. Establish the business, operational, functional, and structural usability requirements of the performance improvement framework.

Figure 1 illustrates how the research activities are combined in the formulation of the proposed framework:

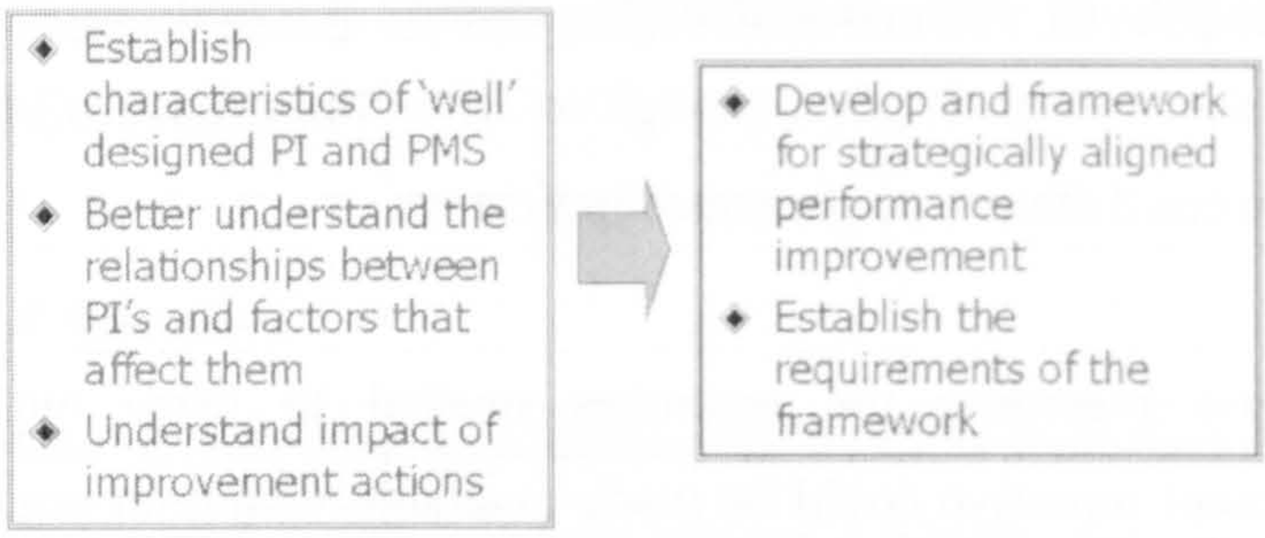


Figure 1 Research development

A theory building research approach is used to develop the performance improvement framework (Res. activities 4&5). The validity of the framework is built up through the step-by-step approach. The performance improvement framework was developed in conjunction with the European Commission funded research project Esprit 26736 TQM-Tile (Performance Measurement for Total Quality Management). The researcher participated in project tasks that provided some background to this thesis. In project tasks that were designed to contribute as core research in this thesis, the researcher has total responsibility and undertook the research activities. The overall research methodology is detailed in Chapter 3.

1.8 Contribution to knowledge

The main contribution to knowledge of this thesis is the extension of the concept of performance indicators to incorporate factors that could affect the indicator, the actions that could be taken to change the value of the indicator, the constraints of these actions, and most importantly the relationships between all these. In the context of a performance measurement system these relationships can allow organisations to make operational improvement decisions in a more structured manner, by taking into account all the relevant factors that affect performance thus allowing the better understanding of causality.

The development of the performance improvement framework takes practicality into account and strikes a balance between theoretical completeness and implementation acceptability. Tools to support user submission and consensus voting of factors and relationships were also developed.

There has been considerable research in the area of performance measurement and ultimately performance improvement. The current work relates to both fields through the understanding of causality in the management of performance.

1.9 Thesis Structure

Chapter 1 – The purpose of Chapter 1 was the introduction of the thesis. The background leading to the problem formulation was briefly explained as well as the industrial context through which the problem is addressed. The research methodology and research objective were presented.

Chapter 2 – Reviews the literature underpinning the research. It provides an overview of the field of performance measurement, the purpose of performance measurement and current developments in the research agenda. It moves on to presenting current performance measurement frameworks and describes the literature regarding the concept of performance management. It also investigates the literature regarding performance improvement and techniques that are being used by establishing their importance and relevance to the research. The chapter concludes with a discussion of the key literature findings, their relevance to the research and identification of the issues, which will be addressed in this thesis.

Chapter 3 – Describes the research methodology and its justification. The conceptual framework developed in the initial stages of the research is laid out and explained. Chapter 3 also discusses the data collection framework and the data analysis process. It also provides a link with the literature findings to demonstrate how the chosen methodology supports them.

Chapter 4 – Describes the research methodology steps in detail with the main emphasis being placed on the theoretical development of the performance improvement framework. The chapter describes the sequence of research actions undertaken to incrementally build up the elements of the framework and sets the foundation for the input from the industrial case studies.

Chapter 5 – Presents in detail the industrial case studies and the case study approach followed. This chapter demonstrates how the case studies provided the necessary input to define the causal relationships in a form appropriate to day to day industrial operations.

Chapter 6 – Presents the validation of the process of performance improvement management. The framework and the process are applied in a small area of a manufacturing organisation where performance improvement is managed based on data collected through the framework.

Chapter 7 – Discusses the results of the research within the context of performance measurement and the research methodology. The framework is also compared with alternative approaches, and the findings are discussed.

Chapter 8 – Summarises the results and concludes the achievements of this research. The limitations of the research are discussed and areas for potential future research are identified.

Chapter 2 - Literature Review

2.1 Overview

To realise performance improvement, actions need to be taken by people within an organisation. Performance measurement affects the behaviour of the people being measured. However, the causal links between measurement and actions are not well understood. This review traces the development of theories in performance measurement to establish the basis for the development of a framework that can capture these causal links into a practical management tool.

The measurement of business performance as a management tool has been supported by many authors (Andersson et al., 1989; Eccles, 1991; Kaplan and Norton, 1992; Schmenner and Volmann, 1994; Kaplan and Norton, 1996b). Most of these authors have stressed the importance of identifying key issues within an organisation, and the contribution that performance measurement can make to focusing attention on these issues and initiate action (Neely, 1998).

The ever-increasing interest in performance measurement has been illustrated by the large number of publications, academic research and practitioner conferences that have taken place over the last twenty years (Neely, 1999). Articles on the topic and reports have been appearing at the rate of one every five hours (Neely, 1998). Despite the considerable interest in the field, the main bulk of the performance measurement research has concentrated on the early stages of performance measurement system development, conceptual frameworks and different processes for designing performance measures (Neely et al., 1997; Bourne et al., 2000). Additionally, recent research suggests that companies that have implemented performance measurement have actually realised advantages over companies that have not (Lingle, 1996). Others, e.g. (Fawcett and Cooper, 1997) stress the benefits of performance measurement over companies that do not use measures to manage their performance. Evidence suggests that the recent nature of performance measurement is still changing (Ghalayini and Noble, 1996; Neely, 2000) and is recognised increasingly as a tool of strategic importance.

This chapter reviews the ever-increasing literature in the area of business performance measurement and the way that performance improvement is used within this context. Section 2.2 investigates the reasons why organisations need to measure their performance, and the different ways that measures are used as well as providing the basic definitions of the several concepts found in the research. Section 2.3 examines and reviews the reasons that triggered the evolution of performance measurement systems and practises, and investigates the positioning of competitive organisations in the environment of performance measurement. The shortcomings of traditional financial based performance measures are discussed in section 2.4 hence establishing the need for companies to rethink and review the way they measure their business performance as well as investigating the concept of performance management. Several performance measurement frameworks are examined in section 2.5 and current practises and ways of multi dimensional performance measurement are reviewed, giving an insight into the ways in which performance should be used in organisations.

Section 2.6 analyses literature on the impact of different variables on performance and elaborates how causal relationships have been used in this context. Performance improvement is the principal concept in section 2.7 where the need for performance improvement within the operating boundaries of a performance measurement system is established and its importance is discussed along with its limitations and restrictions. Section 2.8 presents a critical review of the literature in the field of performance measurement and the chapter concludes with Section 2.9 identifying current gaps and establishing the need for the research and the basis for its development.

2.2 Performance Measurement – Do we need it?

2.2.1 Measurement

Organisations have been measuring their performance in several ways for a number of different reasons. Improved control is one of the main ones. In other words, to control their operations effectively and efficiently and influence behaviour positively, companies need to measure their resulting performance. This measurement of performance is an indication of how well the company is achieving its goals and

competitive priorities and consequently meeting customer requirements. As mentioned earlier in this chapter, there is increasing evidence in literature that the use of performance measures to manage business performance results in performance improvement (Jeanes, 1996; Lingle, 1996; Rucci et al., 1998). This section investigates the literature regarding the use of performance measures and their application and purposes. In the context of the research it seeks to provide greater focus in the understanding of measures and their contribution to the management of performance.

Before we venture into the realms of the literature review analysis it would be essential to present of few basic definitions of different terms used within this document, so as to establish a common understanding (Neely et al., 1995):

- Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action.
- A performance indicator or measure can be defined as a metric used to quantify the efficiency and/or effectiveness of an action.
- A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of action.

Figure 2 illustrates the positioning of the aforementioned elements:

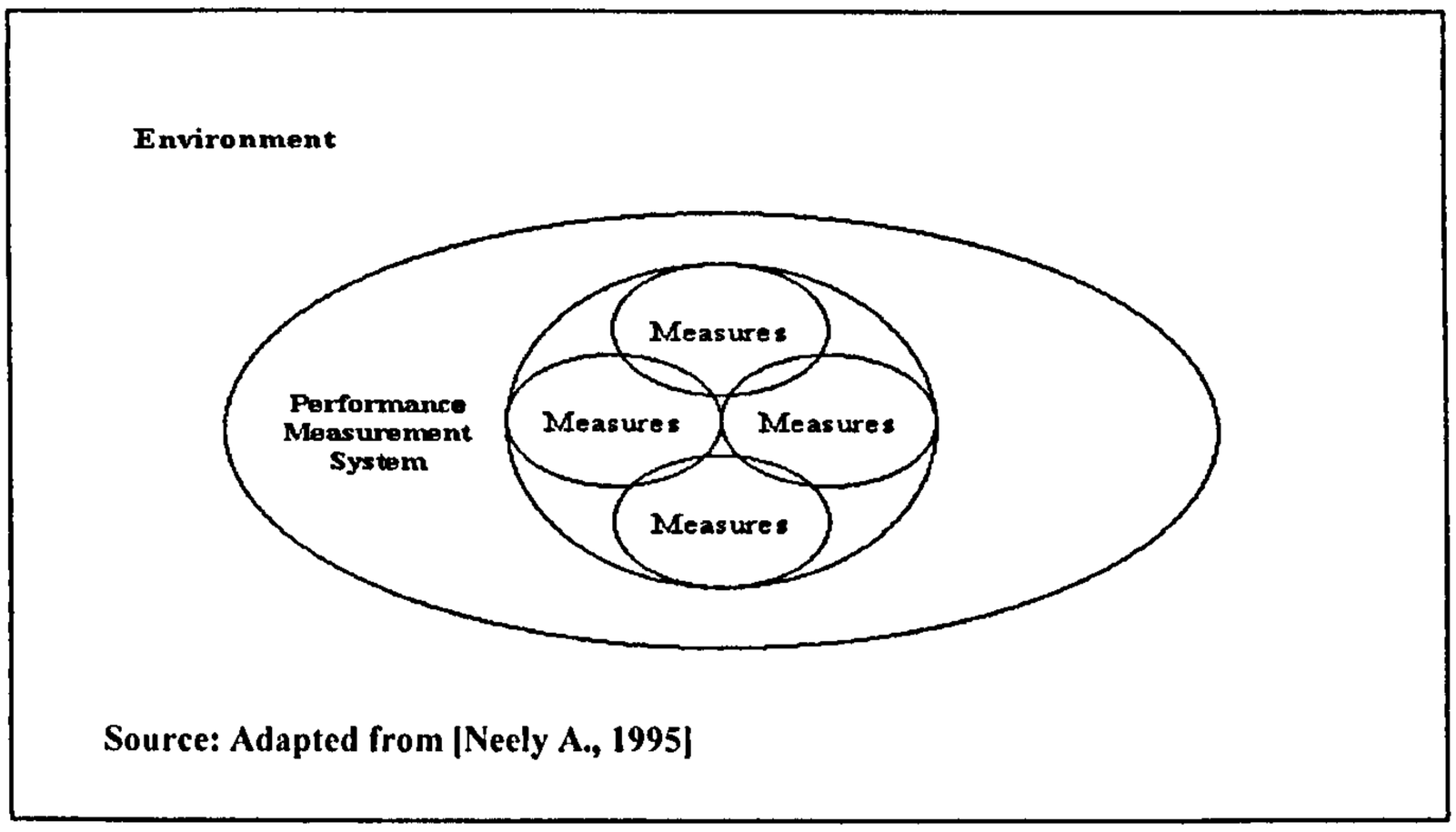


Figure 2 PMS Design Framework

The individual measures are at the heart of the performance measurement system, which in turn interacts with the environment in which it operates.

2.2.2 Performance Measures

Performance measures have been used to measure different things for different reasons, but it is argued (Neely, 1998), that despite such diversity, each of these reasons can fall into one of four generic categories: Checking the position of an organisation, communicating the position, confirming priorities and compelling progress. Another reported use for performance measures is their contribution to decision making (Brown, 1994). Several authors argue the importance of using performance measures to manage activities as part of a strategic control system (Goold, 1990; Nanni, 1990; Simons, 1995; Kaplan, 1996a). Another key use of performance measures within a business is the feedback of information. This has been well documented (Bungay and Goold, 1991; Kennerley et al., 1994) within the context of control systems. It is clear that performance measurement is a "...fundamental way of feeding back performance", (Kennerley, 2000), in that it allows control to be maintained either through monitoring or performance assessment.

A number of authors have suggested the use of performance measures as a tool to communicate objectives, targets and goals (Globerson, 1985; Kaplan and Norton, 1992; Kaplan, 1994). (Neely and Wilson, 1992), suggest that measures can be used to align objectives to improve product goal congruence. (Simons, 1995), states that performance measures can indicate what is important and can identify what is, and what is not acceptable behaviour. A further use of performance measures is in the validation and proof of assumptions (Eccles, 1992; Feurer and Chaharbaghi, 1995; Kaplan, 1996) underlying the company strategies. The information fed back based on this assumption ensures that the strategies are effectively questioned as to whether they produce the desired results. Furthermore, this can act as an input to the planning process and moreover can be the starting point for improvement. (Camp, 1989), suggests that measurement can provide an input to the planning process through careful benchmarking, thus allowing comparison with World Class standards in order to set targets. (Maskell, 1992), supports the notion that continuous improvement is at the heart

of World Class Manufacturing and as such performance measurement should complement that rather than just being used as a management-reporting tool. (Bititci et al., 1997) further supports this notion by stating that performance measures should enable continuous improvement and support business objectives. To this end several authors have stressed the importance of continuous improvement within the context of performance measurement (Fischer, 1992; Ghalayini and Noble, 1996). Therefore, the aim of any well-designed performance measurement system should be to support and complement this concept, as a management tool.

There have been several instances in literature where authors attempted to develop guidelines for designing performance measures and performance measurement systems (Neely, 1996; Bititci et al., 1997; Bourne, 1999). There have also been a wide variety of criteria developed for the design of good practice performance measures and measurement systems. The different attributes of effective performance measures and measurement systems that have been found in literature are summarised in the following sections of the thesis.

2.2.3 Performance Measure Attributes

This section summarises the attributes relating to 'well' designed performance measures and their design:

- Performance measurement systems should contain a balance of performance measures including financial and non-financial, long term and short term, internal and external, so that the organisation can etsblishe a much more balanced view of their performance and its drivers (Fortuin, 1988; Andersson et al., 1989; Keegan et al., 1989; McNair, 1990; Azzone et al., 1991; Kaydos, 1991; Maskell, 1991; Kaplan and Norton, 1992).
- Performance measures should be derived from an organisation's strategic objectives and mission, representing the companies competitive positioning and customer requirements (Globerson, 1985; Maskell, 1989; Wisner and Fawcett, 1991; Kaplan and Norton, 1993; Bititci, 1994).

- Performance measures must relate to the potential for improvement and support the concept of ever increasing excellence (Maskell, 1989).
- Performance measures should be linked to specific processes within the company (Zairi and Hutton, 1995; Neely, 1996; Najmi et al., 1999)
- Performance measures should be clearly and explicitly defined and not contain any ambiguity that may be misunderstood. They should also be relevant to the quantity being measured (Globerson, 1985; Bungay and Goold, 1991; Maskell, 1991; Blenkinsop and Burns, 1992).
- Performance measures should be ratio-based rather than absolute numbers, and should be objective, rather than based on opinion to allow easier comparison to previous performance and other organisations (Globerson, 1985; Fortuin, 1988; Maskell, 1989).
- Performance measures should employ a meaningful and appropriate scale of measurement and must relate to specific, achievable but stretching goals (Globerson, 1985; Kaydos, 1991).
- Performance measures should be easy and simple to understand and highly visible to all, thus promoting transparency throughout the organisation. Moreover measures must incur visual impact on the organisation's performance and mainly concentrate on improvement rather than variance (Hall, 1983; Lea, 1989; Crawford, 1990; House and Price, 1991).

2.2.4 Performance Measurement System Attributes

This section summarises the attributes relating to 'well' designed performance measurement systems and their mechanisms:

- A performance measurement system should be designed by taking into consideration the links between organisational strategies, performance measures and actions (Dixon et al., 1990; Beischel and Smith, 1991; Lynch and Cross, 1991; Kaplan and Norton, 1992; Neely, 1996; Kaplan and Norton, 1996b).
- A performance measurement system should form an integral part of an organisation's management process to ensure that all information received is

analysed and acted upon (Globerson, 1985; Kaplan and Norton, 1992; Brown, 1994; Bititci et al., 1997).

- The performance measurement system should include mechanisms that ensure that measures and targets are reviewed and changed appropriately (Wisner and Fawcett, 1991; Kaplan, 1994; Lingle, 1996; Neely, 1996; Bourne et al., 2000).
- A performance measurement system should contain internal and external performance measures. Internal measures are used to monitor the performance of an organisation in regards to its internal functioning, whereas external measures are used to measure the organisation's performance as perceived externally, i.e. by its customers, or used to evaluate entities external to the organisation, i.e. suppliers. There have also been instances where the aforementioned measures have also been further split into input (supplier), process (internal) and output (customer) (Kaplan, 1983; Fortuin, 1988; Keegan et al., 1989; Azzone et al., 1991).
- The processes and systems in place for data collection and measurement should provide accurate and timely feedback of achieved performance, and be flexible and adaptable to potential changes in circumstances. They should also encourage and stimulate continuous improvement, rather than just performance monitoring (Globerson, 1985; Maskell, 1989; Lynch and Cross, 1991; Wisner and Fawcett, 1991).
- It is supported that corporate goals and strategies should be cascaded down to separate business units and functions within the organisation through the use of appropriately defined measures. This ensures that strategies are related to measures and organisational objectives remain consistent (Son, 1987; Fry, 1989; Keegan et al., 1989; Blenkinsop and Davis, 1991; Wisner and Fawcett, 1991; Kaplan and Norton, 1996c; Bititci et al., 1997).
- The operational objectives of the organisation and the relevant performance measures should reflect strategic objectives, in a hierarchical structure of measures that allows actions to be consistent (Wisner and Fawcett, 1991; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c).

2.2.5 Performance Measure Classification

Additional to the number of performance measure guidelines found in literature, there are a number of performance measure classifications, reflecting the large number of measures actually used in practice. The following section provides an overview of the main themes:

- Financial and non-financial. It is now generally accepted that traditional financial oriented measures are no longer sufficient to accurately measuring a company's performance hence there is a need for the inclusion of non-financial measures as well. Amongst others, some of the authors supporting the notion are (Fortuin, 1988; Andersson et al., 1989; Keegan et al., 1989; McNair, 1990; Azzone et al., 1991; Kaydos, 1991; Maskell, 1991; Kaplan and Norton, 1992).
- Efficiency and effectiveness measures. In essence performance measurement is an analysis of both effectiveness and efficiency in accomplishing a given task (Mentzer, 1991). Effectiveness measures measure the extent to which goals are defined, and efficiency measures measure how well the resources allocated are utilised. It is important to note that it is not sufficient to measure efficiency alone. As (Andersson et al., 1989) state in one of their case studies, if that were the case, then doing nothing would be the best scenario for an efficiency measure. Authors supporting this include: (Fortuin, 1988; Andersson et al., 1989; Mentzer, 1991).
- Internal and external measures. These relate to the need for including measures that assess external performance i.e. how well is the organisation performing based on the customer's viewpoint, and internal performance, i.e. measures that are used to assess the internal functioning of the organisation. Supporting authors include: (Kaplan, 1983; Fortuin, 1988; Keegan et al., 1989; Azzone et al., 1991).
- Input and output performance measures. It is argued that in a balanced performance measurement system it is important to include indicators that measure the input and the output of a specific process, in order to be able to derive efficiency and effectiveness measures. Amongst other authors: (Fortuin, 1988; Stoop and Bertrand, 1997).

- Cascading measures. It is supported that corporate goals and strategies should be cascaded down to separate business units and functions within the organisation units through the use of appropriately defined measures. This way, strategies are related to measures and organisational objectives are consistent (Son, 1987; Fry, 1989; Keegan et al., 1989; Blenkinsop and Davis, 1991; Wisner and Fawcett, 1991; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c; Bititci et al., 1997).
- Specialisation. Several authors argue that measures should reflect their area of application, thus different measures should be used in different areas of an organisation (Edson, 1988; Fortuin, 1988; Azzone et al., 1991; Kaydos, 1991).

More recent research (Flapper et al., 1996), has built upon these classification categories and expanded them in order to gain a deeper insight into the relationships present between measures in a performance measurement system to include areas such as:

- The decision type of the measure (strategic/tactical/operational). This division is based on the timescale of the decision a measure is related to.
- Aggregation level. If the overall performance is assessed, following the systems approach, then we are talking about overall measures as opposed to partial measures that relate to individual parts of the organisation.
- Measurement unit. This category classifies the unit of measurement depending on whether it is financial, physical or dimensionless

The previous three points are summarised in Figure 3.

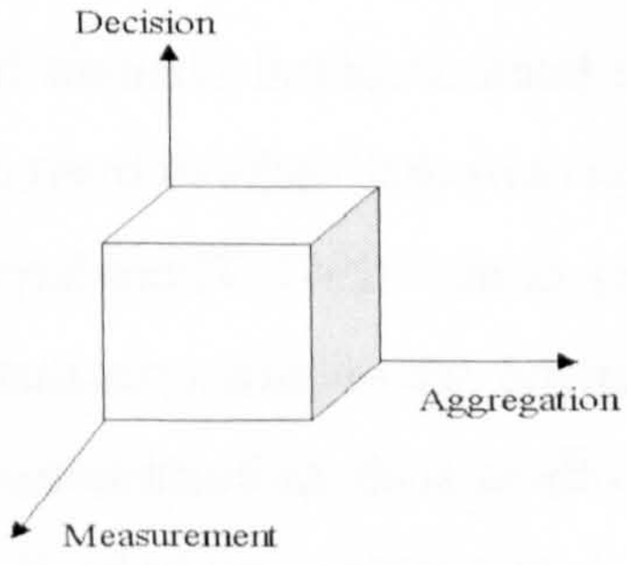


Figure 3 Dimensions of performance measures (Flapper et al., 1996)

2.2.6 Measures and Measurement

One of the main themes argued in literature is the notion that the number of measures used in companies should be limited and should concentrate on the main competitive priorities of the company (Azzone et al., 1991; Kaydos, 1991; Maskell, 1991). Other authors support that the simultaneous achievement of business objectives within the context of World Class performance, dictates the use of a large number of measures that cover a wide range of priorities (Kennerley, 2000). However, recent research (Johnston and Fitzerald, 2000) suggests that there is evidence that this leads to complex and difficult to use performance measurement systems, that lose their focus on managing and improvement due to the need to allocate resources to efficiently manage such a large number of measures. Others also support that nowadays the problem is increasingly that too much is being measured (Neely, 2000). Indeed, the same author had laid the issue of reduction of total number of measures onto the performance measurement research table a few years earlier (Neely et al., 1995). It is evident in literature that throughout the evolution of the interest in performance measurement there have been instances where the focus on measurement shifted towards the inner workings of measurement system itself rather than its effect on business performance (Johnston and Fitzerald, 2000). Other authors (Dixon et al., 1990) suggest that there is a need for deep change when implementing a new performance measurement system, and that new measurement and reporting practices should be implemented as well. The emphasis should be on strategic objectives from which actions should be derived rather than management accounting practices thus reducing the importance of current reports (Schonberger, 1992). In one case study (Dixon et al., 1990) a company successfully kept its performance measurement system separate from its current external reporting system, to allow continual change to remain unaffected by traditional practices.

Performance measures have been a central element in the research into the design of performance measurement systems that seeks to overcome their traditionally narrow and uni-dimensional focus (Neely et al., 1997). There have been attempts to overcome this limitation by designing balanced set of measures that represent not only the financial side of a business but also others such as customers, employees and internal business processes (Kaplan and Norton, 1992; Kaplan and Norton, 1993; Kaplan, 1994).

2.3 The Evolution of Performance Measurement

2.3.1 The Changing Business

Since the early twentieth century manufacturing practices, which basically stated that consumers could only have what was being produced, market orientation and consumer attitude have changed dramatically. Companies have over the years changed the way they operate to meet these new customer attitudes. Customers gained more purchasing power, goods became more and cheaper thus companies had to adapt their internal and external operations to be able to meet these requirements.

Events such as the globalisation of markets, new emerging technologies and the reduction in trade restrictions – especially within the European Union and with the advent of treaties such as NAFTA (North American Free Trade Agreement) and EFTA (European Free Trade Agreement) - competition has intensified leading to a continuous cycle of new developments affecting both companies and consumers. The power of the consumers has also increased and is now the main factor that shapes company attitudes and practices. The main theme that emerged in the 1980's and 1990's was getting to the customers what they want, when they want it and at the right price. Price was no longer the sole issue in a buying decision, customers were prepared to pay a bit extra for things such as quality, service, and reliability (Neely and Wilson, 1992). As a result, as markets changed, so did the strategies companies employed. Moreover, with the emergence of management philosophies and concepts such as (Just-In-Time) JIT, Total Quality Management (TQM) and Flexible Manufacturing Systems (FMS), the need to change became even more apparent.

2.3.2 The Emergence of Operations Strategy

The role of the operations management function i.e. to minimise production costs (Chase and Aquilano, 1995) remained virtually unchanged throughout the 1950's and 1960's. By the late 1960's at the Harvard Business School, C. Wickham Skinner, recognised this weakness amongst U.S. manufacturers and suggested the need for an operations strategy to support and complement existing marketing and finance strategies. He was the first one to identify that the manufacturing task should include the dimensions of cost, deliveries, lead times, quality and reliability to meet customer

demands (Skinner, 1969). Subsequent work by other researchers (Wheelright, 1978; Hayes and Abernathy, 1980; Hayes and Garvin, 1982) emphasised the importance of using a company's manufacturing facilities as a competitive weapon. (Wheelright, 1978) added the dimension of flexibility when considering the competitive priorities of a company. Chase and Aquilano, (Chase and Aquilano, 1995) categorise the competitive priorities into four categories based on the work of Skinner and others:

- Cost
- Quality
- Speed of delivery
- Flexibility

Following their extensive research into the manufacturing strategy literature (Leong et al., 1990) expand the concept by establishing that the key dimensions of manufacturing performance are a function of quality, delivery (speed and reliability), cost (price) and flexibility. These four dimensions translate directly into characteristics used to direct and measure manufacturing performance. However, although these terms are frequently used, the context from which they are used varies depending on the application.

The development of competitive priorities was triggered by the need to satisfy changing customer requirements. Nevertheless, Kennerley (Kennerley, 2000) supports that to achieve that in an efficient and effective way, a company must seek to improve their internal operations in tandem. Hence, the competitive priorities of cost, delivery, time and flexibility relate to both internal and external operations for organisational improvement.

2.3.3 Competitive Priorities

In order to understand the terms of competitive priorities it is essential to define the context in which they are used. As mentioned earlier in this chapter, although these terms are used frequently in literature, there is still confusion as to what they exactly mean (Neely et al., 1995).

Quality

The traditional concept of quality refers to conformance to specification and as a result, traditional measures of quality tended to concentrate on issues such as defect rates, and the cost of quality (Neely et al., 1995). To this end, several authors (Feigenbaum, 1961; Campanella and Corcoran, 1983) identified that the cost of quality is related to prevention, appraisal and failure costs. (Campanella and Corcoran, 1983) offer the following definitions:

- Prevention costs are costs that are related to the prevention of bad quality such as quality planning, supplier quality surveys and training programmes
- Appraisal costs are costs incurred by the evaluation of product quality and the efforts focused on the detection of bad quality, such as inspection, test and calibration control.
- Failure costs are the cost resulting by bad quality, and are divided into two categories:
    - Internal failure costs – These are costs incurred prior to delivery to the customer, such as rework, scrap etc.
    - External failure costs – These are costs incurred after delivery to the customers, such as warranty claims, returns, complaints etc.

The above concept led to Crosby's suggestion that quality is free (Crosby, 1972). The assumption underpinning this statement is that, an increase in prevention costs will be more than offset by a decrease in failure costs (Neely et al., 1995). However, the main implication of the concept of cost of quality is that there is an optimum level of quality, i.e. a balance between investing in prevention and appraisal costs and a reduction and other gains related to failure costs. Following this analysis an appropriate definition of quality would be:

" Quality means meeting customers' (agreed) requirements, formal and informal, at the lowest cost, first time every time". (Flood, 1993)

Expanding the concept, quality can be divided into two categories: product/service quality and process quality. The level of quality in a product's design will vary as to the market segment it is aimed for (Chase and Aquilano, 1995). Hence, the goal in establishing the proper level of product quality is to focus on the requirements of the customer. Process quality is critical in any market segment. Process quality aims at providing error-free products through Total Quality Management (TQM). With the advent of TQM the emphasis shifted from conformance to specification to customer satisfaction, an event that shaped modern markets up to this day. Consequently, we define Total Quality Management as: " The management of an organisation so that it excels on all dimensions of products and service that are appropriate to the customer ".

Cost

Within every industry there is usually a segment of the market that strictly operates on the basis of low cost. To successfully compete in that sector, a firm must strive to be the low-cost producer. But even by doing this, it does not guarantee success and profitability.

To achieve this many companies seek to reduce cost incurring activities throughout their operations. This led to the development of complex cost accounting systems, that have been well documented and subject of considerable researches. To this end, the identification, measurement and elimination of non-value adding activities should be a key objective of any performance measurement implementation attempt (McNair and Mosconi, 1987). As a result, the focus is shifted from purely the reduction of cost – which has been the main focus of traditional accounting systems- and moved onto the better design and operation of processes within the organisation. However, it is important to equally consider cost reduction and improvement gained in alignment with business objectives (Kennerley, 2000). (Andersson et al., 1989), in their study of the performance measurement of the logistics process state that: "..If the mission of a department was only to strive for efficiency and cut costs alone, then the best thing would be to do nothing…so this calls for a need for effectiveness measures".

Traditionally, the focus on cost reduction was mainly concentrated on direct costs. Nevertheless, as we have seen over the years, overhead costs became more significant, and the need to include indirect costs in the cost reduction programme was established. As a result to all the criticism towards traditional management accounting systems, a new approach called Activity Based Costing (ABC) was developed by (Cooper, 1988). It is argued that ABC was developed because of the need for a more accurate understanding of the source of costs, since the previously mentioned issues rendered traditional accounting system irrelevant (Neely et al., 1995). ABC attempts to allocate costs to products based on the activities that produce them.

There have been instances in literature regarding the benefits and advantages of ABC (Innes and Mitchell, 1990; Troxel and Weber, 1990), and also some criticism of the concept (Piper and Walley, 1990; Piper and Walley, 1991). Nevertheless, ABC acted as a stimulant that initiated a welcome rethinking in the allocation of costs and overcome traditional problems of accounting systems. The accounting field has been relatively slow in addressing the changing needs of modern manufacturing organisations. There is still active research in the field, looking at new ways that accounting systems can be revised to reflect these needs, since they can act as an obstacle to the development of new ideas (Bromwich and Bhimani, 1989).

Delivery

Time has been a key element in manufacturing strategy and a source of competitive advantage (Stalk, 1988; Azzone et al., 1991). (Zairi, 1992) argues that time is considered to be the ultimate measure of performance and that concept encompasses product to market time, total cycle time, changeover times amongst others. The importance of time is clearly demonstrated by the concept of Just-In-Time (JIT) production where anything later or even earlier than on time is considered a failure. Indeed, short delivery times can be a key component in a company's success. The ability of a company to provide fast and dependable delivery allows it to increase its competitive advantage, either by means of charging increased premium or by increasing its market share through customer preference.

The objective of effective delivery can be divided into two key components: delivery speed and delivery flexibility (Leong et al., 1990). Delivery speed relates to the ability of an organisation to deliver goods and services quickly. Delivery reliability on the other hand, relates to the ability of an organisation to deliver goods or services when agreed. The combination of these two components forms the basis for delivery repeatability, i.e. the ability to deliver swiftly and reliably time and time again. This concept is especially important to company-supplier relations. To this end, this clearly relates to the Time-To-Market performance indicator, used -amongst other things- to assess the responsiveness of a company towards market changes. Extending the concept, it is suggested that organisations might pursue policies concentrating on either one of the two delivery components (Kennerley, 2000). For example, it has been mentioned that it would be possible to build up a reputation for delivery reliability while being uncompetitive in regards to delivery speed. New (New, 1992) suggests that, policies on delivery reliability and delivery speed should be based upon the market in which they are placed and customer requirements.

Flexibility

Although flexibility is an objective that is being widely mentioned in literature, still many definitions of it exist. Indeed, flexibility can be seen as the ability of a company to vary production volumes (Wheelright, 1984). It can also be viewed as a characteristic of an organisation's ability to introduce new products quickly (Tunalv, 1992). A number of authors (Slack, 1983; Gerwin, 1987; Slack, 1987; Cox, 1989) have published work on flexibility and the issues surrounding it. Some of the issues raised were the concept of flexibility as a means of efficiently changing the manufacturing process (Cox, 1989), whereas Slack (Slack, 1983) supports the notion that flexibility is a two dimensional objective including: range and response. Range refers to the size of the change and response refers to how rapidly and quickly this can be accomplished (Slack, 1987).

The objective of flexibility is quite complex and difficult to define since it is a measure of potential rather than performance (Slack, 1983). Moreover, it is quite unclear since it does not explicitly relate to only one single discipline within an organisation. Consequently, care should be taken when defining flexibility as an objective to avoid

confusion (Kennerley, 2000). A key element in defining flexibility as an objective is that it essentially describes the ability of an organisation to compete on cost, quality and delivery under conditions which are not know or uncertain.

Time and cost are properties critical to the definition of flexibility, because if they are not considered then the objective of flexibility becomes distorted. Flexibility should be a function of time (how quickly to change) and cost (in an efficient manner) otherwise it becomes irrelevant to an organisations strategy. It is argued that resources are the key difference between flexibility and fundamental change (Slack, 1983).

Research into the field of flexibility (Gupta and Goyal, 1989; Gupta, 1993; Benjaafar and Tirupati, 1998) has provided an insight into the different types of flexibility and the different definitions used. Despite of the extensive literature on the subject (Sethi and Sethi, 1990), and widespread recognition that flexibility is a significant competitive weapon in an organisation (Hayes and Wheelwright, 1984), flexibility still remains a subject, which is difficult to operationalise (Gupta and Buzacott, 1989). As a result the most appropriate definition for flexibility would be: the ability of an organisation to cope with change.

2.3.4 Strategic Trade-offs and Competitive Priorities

Central to the concept of operations strategy, during the late 1960's and early 1070's was the notion of factory focus and trade-offs. Indeed most of Skinner's early work (Skinner, 1969) is based on the assumption that there are trade-offs between the strategic objectives discussed in section 2.3.3. (Porter, 1985) amongst others, suggested that it is essential to focus on one strategic objective to gain competitive advantage, otherwise there is a danger of getting 'stuck in the middle' by paying attention to more than one objectives at a time . The underlying logic was that an organisation could not excel simultaneously on all four performance objectives. Consequently, it was up to management to decide which parameters of performance were critical to the company's success and then focus the resources of the firm on those particular characteristics. For example, it was believed that a low-cost strategy was not compatible with either speed of delivery or flexibility and similarly a strategy focusing on delivery would not be

compatible with flexibility. (Skinner, 1974), even suggested the creation of a plant-within-a-plant (PWP) concept, in which different locations within the facility would be allocated to different product lines, each with their own operations strategy. Under the PWP concept, even the workers would be separated to minimise the confusion associated with shifting from one type of strategy to another.

The concepts of factory focus and PWP are still widely used today (Chase and Aquilano, 1995). However, the notion of trade-offs has given way to the need to do everything well and the issue has instead become determining priorities.

2.3.5 Establishing Priorities

Skinner's views were contradicted on subsequent work by authors who suggested that some of the traditional assumed trade-offs do not necessarily exist and that more than one strategic objective can be improved simultaneously (Wheelright, 1981). In their book "*The machine that changed the world*" Womack et al, support that strategic objectives are not conflicting and can be mutually beneficial (Womack et al., 1990). For example, an improvement in quality could result in an improvement in cost, whereas Skinner had suggested that there was an incompatibility trade-off between these objectives.

As a one-world economy evolved, a group of companies emerged that adopted an international perspective towards both manufacturing and marketing. Within this global area competition is significantly increased due to the greater number of competitors and the increased opportunities that exist. Often, companies that excelled on the international level have been called World Class Manufacturers. Events in the world marketplace, during the 1970's and 1980's, in terms of the growing intensity of competition, forced these companies to re-examine the concept of operations strategy, especially in terms of the so called necessary trade-offs. Schonberger was one of the first to suggest that no such trade-offs exist (Schonberger, 1986; Schonberger, 1990)

Managers began to recognise that they did not really have to make trade-offs between these different strategies. What emerged instead was a realisation for the need to

establish priorities among the four strategies as dictated by the marketplace. A volume of literature recognised that despite the number of companies that had managed to overcome the obstacle of assumed trade-offs (Wheelright, 1981; Womack et al., 1990; Pine et al., 1993), the number of organisations that do actually put in practice the concept of simultaneously achieving optimum performance shows little evidence that these trade-offs do not exist (New, 1992). New also suggested that all actions taken to improve performance should be in relation to the appropriate combination of strategic objectives (New, 1992).

As the 'rules' for operations strategy shifted from that of primarily reducing manufacturing costs to that of including quality, delivery and flexibility, the paradigm for the operations management function has also shifted. The paradigm of minimising production costs has been replaced with that of providing full service to the customer. To this end, companies should strive to find the optimum combination of these objectives depending upon their competitive circumstances. The study of the interrelationship of the factors affecting the achievement of these objectives is a key element in the assessment of performance. These objectives should be in balance and one should not be promoted at the expense of another (Hazell and Morrow, 1992). (Garvin, 1983), supports the notion that each element within an organisation must cooperate and work within the overall demands and direction of the organisation. Although, customer significant priorities should be a driving force in a company's success, this should not be done at the expense or exclusion of other objectives (Kennerley, 2000). Consequently, as objectives and measures change according to customer requirements so do the priorities of an organisation.

The study of trade-offs and the establishment of priorities has led to the conclusion that within the complexity of an organisation, there is a need to have a clear direction of the overall business. Although, at a higher level trade-offs and how they can lead to sub-optimisation of performance have been considered, there has been little discussion of these issues at an operational level. Thus, a significant gap exists in literature relating to the impact of low-level actions on operational performance, and how that contributes to the achievement of business objectives through a balance of dimensions.

2.4 Shortcomings of Traditional Financial Oriented Measures

Businesses have been traditionally measuring their performance in terms of financial criteria. Such measures are used to define the overall financial performance of an organisation. This is based on the simple principle that every part of the organisation must work towards increased profitability. Some authors might argue at this stage that the main goal of every company is not profit but to make money (Goldratt and Cox, 1992). Nevertheless, the heart of the matter is that businesses have traditionally strived to improve their performance based on financial measurements. However, the financial performance of any organisation is a function of many processes and activities. In order to have access to a more accurate picture of the financial performance of an organisation and how that performance was achieved, it is important to assess and analyse the individual performance of these activities, their interaction and their impact on the overall performance of the business (Kennerley, 2000).

Performance measurement has its origins in management accounting practices that were developed in the late nineteenth and early twentieth centuries (Johnson and Evans, 1997). Most of the managerial decision-making and control systems in use in the late 1980's were described as stagnated (Johnson and Kaplan, 1987). The development of such management accounting systems has been closely monitored over two to three decades by several authors (Johnson, 1975; Johnson, 1983; Kaplan, 1984a; Kaplan, 1984b; Johnson and Kaplan, 1987). Many of the deficiencies of those systems were highlighted, (Zairi, 1994) and a deeper insight was provided into how those systems were used for managing a business. They also discussed the failure of the performance measurement systems to respond to the changing environment, due to the fact that firms in the mid-1980's were still using 30 year old management accounting practices.

Traditional financial performance measures do indeed provide important and necessary information, but they do not relate to the strategy contributing factors in the business and do not contribute to improved performance. (Johnson, 1992), argues that this is a limitation of the use of the accounting system as a management tool rather than the information itself being inappropriate. Several authors have discussed the limitations of traditional performance measures (Kaplan, 1983; Hayes et al., 1988; McNair et al., 1989; Woods,

1989; Kaplan, 1990; Eccles, 1991; Maskell, 1991; Fischer, 1992). Others highlighted the gap between the current methods of operation for manufacturers and the existing performance measurement systems (Fitzgerald, 1988; Kaydos, 1991). The following is an attempt to list the most eminent limitations of traditional performance measures and systems found in literature.

- Traditional performance measures have been based on traditional accounting systems that were initially developed when labour was still the main cost driver in a business (Zairi, 1992; Ghalayini and Noble, 1996). Other important costs were collectively put under the overheads category. However, labour rarely exceeds 12 percent while overheads are usually between 50-60 percent of the manufacturing cost (Kaplan, 1984b; Business Week, 1988).
- They do not support organisational strategies and priorities, and mainly concentrate on objectives such as cost reduction, and labour and machine utilisation increase (Skinner, 1974; Maskell, 1989; Ghalayini and Noble, 1996).
- They are not representative of true customer requirements such as quality, delivery and flexibility (Johnson and Kaplan, 1987; Maskell, 1989).
- They encourage short-termism (Hayes and Abernathy, 1980; Kaplan, 1986).
- They are inflexible in that they are based on reports of a predetermined format across all functions in a business, effectively ignoring individual departmental priorities and characteristics (Richardson and Gordon, 1980; Ghalayini and Noble, 1996).
- They are expensive to manage. The amount of data usually required dictates for frequently expensive data collection methods (Ghalayini and Noble, 1996).
- They focus on internal rather than external activities effectively ignoring important external entities such as competitors and customers (Kaplan and Norton, 1992; Neely et al., 1995; Fitzerald and Moon, 1996; Ghalayini and Noble, 1996).
- Traditional measures concentrate mainly on variances rather than improvement and problem solving (Banks and Wheelwright, 1979; Hayes and Garvin, 1982).
- Financial measures are by nature lagging metrics, a result of past decisions. Consequently, financial reports are of little use to operational managers when considering performance improvement since the information is already too old and

all too frequently stems from several levels away from the relevant activities (Johnson and Kaplan, 1987; Kaydos, 1991; Zairi, 1992; Ghalayini and Noble, 1996).

- Traditional measures attempt to quantify performance and other improvement activities in financial terms. However, most of these activities are difficult to express in terms of money and as a result traditional measures are too often ignored at the shopfloor (Ghalayini and Noble, 1996).
- Traditional performance measures do not encourage continuous improvement (Fischer, 1992; Ghalayini and Noble, 1996).
- They usually reflect functional structures and not key processes, and can sometimes result in the sub-optimisation of performance along functional lines (Hall, 1983; Fry, 1989).
- They can reveal a problem but provide little in regards to the nature and its causes e.g. profit as a measure (Globerson, 1985; Kaydos, 1991; Ghalayini and Noble, 1996).
- They tend to encourage actions without examining whether they are needed or not (Kaydos, 1991).
- Traditional accounting methods emphasise extensively on cost reduction including overheads such as research and development, market research and product development. Encouraging the reduction of such costs will lead to lost business to competitors and lack of new product development opportunities, as well as a lack of improvement activities aiming at improving existing processes (Connel, 1993).
- Traditional accounting systems consider stock as an asset and therefore can unfairly benefit the company in financial reporting. Moreover, this notion directly opposes modern manufacturing philosophies concepts such as JIT (Hall, 1983; Drucker, 1990).
- Traditional performance measures do not support continuous improvement. (Fischer, 1992) argues that in some cases the inappropriate setting of targets leads to personnel reluctant to achieve their full potential.
- Traditional performance measures fail to take into account the customer perspective either externally or internally (Zairi, 1992).

- Traditional performance measures often track performance in isolated areas (Zairi, 1992).
- Modern management concepts such as TQM, JIT, DFM and FMS are not supported by traditional performance measures and in some cases are hindered by them (Kaplan, 1984b; Edwards, 1985; Maskell, 1989; Zairi, 1994).

Several authors have extensively discussed the limitations of specific financial based performance measures and economic models of performance measurement including: Return on Investment (ROI), Performance to Standard (PS), and productivity measures (Johnson and Kaplan, 1987; Zairi, 1992; Zairi, 1994; Ghalayini and Noble, 1996). The rational behind the development of such measures and their applicability has also been explained (Zairi, 1992; Zairi, 1994) in an attempt to understand the factors that led to their establishment. This also led to the realisation that new evolving technologies and new market orientations dictated the use of new and modern performance measures. The shift from management to customer-driven (Zairi, 1994) practices, and the need for measures that support organisational strategies (Dixon et al., 1990; Vollman, 1991), initiated a trend that increasingly suggested the need for a change in the way that businesses measure their performance (Eccles, 1991). What quality was in the 1980's was now being replaced by customer satisfaction, hence the need for new measures that would accommodate the emerging strategies and business practices.

A number of authors have discussed the characteristics of modern performance measures designed specifically to address these issues (Hayes et al., 1988; Dixon et al., 1990; Maskell, 1991; Zairi, 1992; Neely et al., 1997). (Ghalayini and Noble, 1996), attempted to compare these measures to traditional ones to highlight their differences as Figure 4 illustrates:

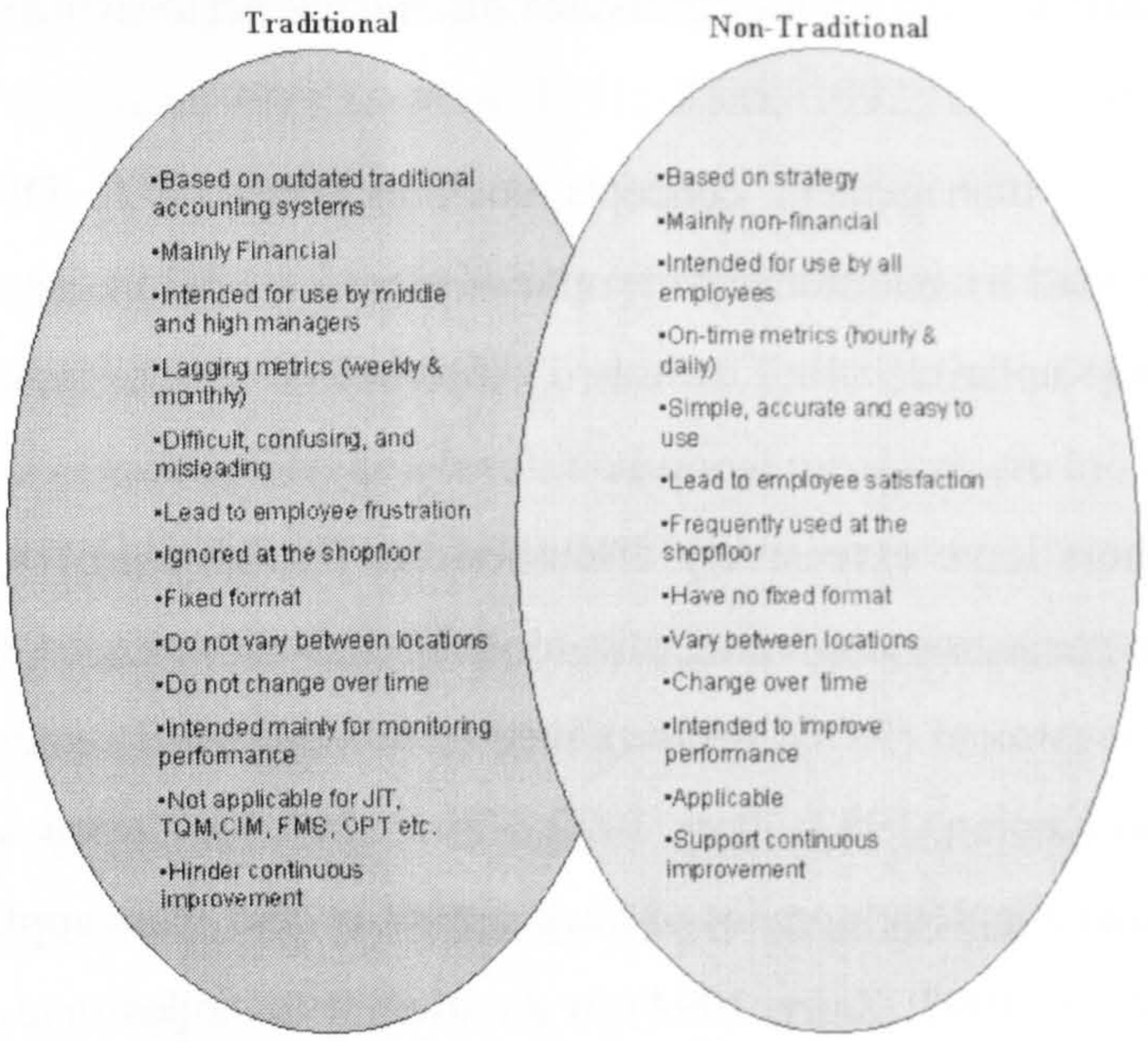


Figure 4 Performance measure comparison (Ghalayini and Noble, 1996)

As markets and competition change, so do company strategies and so should the supporting performance measurement systems, to contribute effectively to a company's success. Despite evidence that there is a shift in the way that performance measurement is performed, most current measures do not reflect the most important issues relevant to this new business era (Maskell, 1992; Kennerley, 2000). Most of the measures still used are mainly financial and as a result inherit all the limitations previously discussed.

2.5 Performance Measurement Frameworks

2.5.1 Extending Measurement

The late 1980's and early 1990's saw the beginning of a movement that started seeking solutions to all the criticism that traditional performance measures had received. As was mentioned earlier in this chapter, it was quite evident that traditional accounting measures were insufficient and inappropriate in leading companies into the demanding markets of the late 20th and early 21st centuries. Eccles (Eccles, 1991) prophesised that: "Within the next five years, every company will have to redesign how it measures its business performance". It was becoming obvious that for companies to remain competitive, they would have to measure a wider variety of things that contribute to

their strategy. Probably, the biggest leap in that direction was the realisation that just using financially based measures was simply not enough (Kaplan, 1983; Kaplan, 1984a; Kaplan, 1984b; Johnson and Kaplan, 1987; Andersson et al., 1989; McNair, 1990). On top of the crucial financial measures there was a need to measure other entities crucial to a company's success such as customer satisfaction, employee satisfaction, internal processes and internal development amongst others. To this end, a number of performance measurement frameworks were developed, in an attempt to aid the inclusion of different perspectives of performance in a company's performance measurement system. Moreover, they sought to give companies a more comprehensive insight into the different dimensions of business performance, and assist them in how to measure it. This section will present several performance measurement frameworks that have been developed throughout the years, and discuss their strengths, weaknesses and application boundaries. These frameworks reflect the changes in performance measurement and attempt to address the limitations of traditional performance measures.

2.5.2 Existing Performance Measurement Frameworks

One of the first performance measurement frameworks is the performance measurement matrix (Keegan et al., 1989). This framework strongly reflects the need for balanced measurement and as a result classifies measures in four categories: Cost, Non-Cost, Internal and External. Being one of the early frameworks, it is quite simple and still does not include certain areas of performance that are increasingly significant to current businesses (Kennerley, 2000), but nevertheless it successfully seeks to integrate different dimensions of performance hence being reasonably flexible (Neely et al., 1995). According to (Neely et al., 1995), the matrix should be able to accommodate any measure of performance, thus enabling an organisation to develop and deploy its measures from a balanced perspective. Figure 5 illustrates the concept:

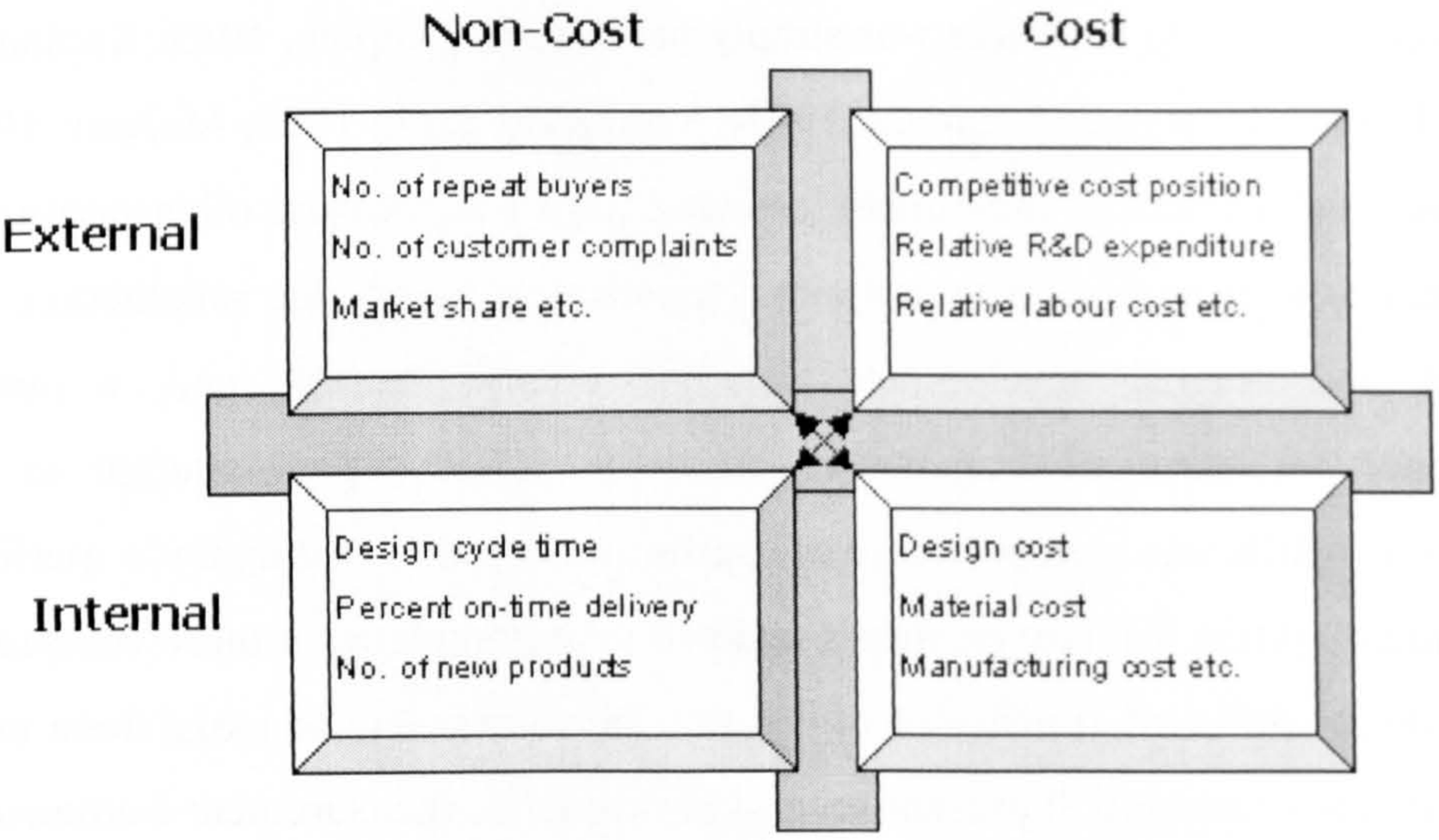


Figure 5 The performance measurement matrix (Keegan et al., 1989)

The SMART (Strategic Measurement and Reporting Technique) system (see Figure 6) was developed by Wang Laboratories Inc. (Cross and Lynch, 1988-1989) as a result of dissatisfaction with traditional performance measures, such as utilisation, efficiency, productivity etc. (Ghalayini and Noble, 1996). The main objective was to develop a performance measurement system with measures designed to effectively define and sustain success. The SMART system also supports the need to include measures from both internal and external dimensions of performance.

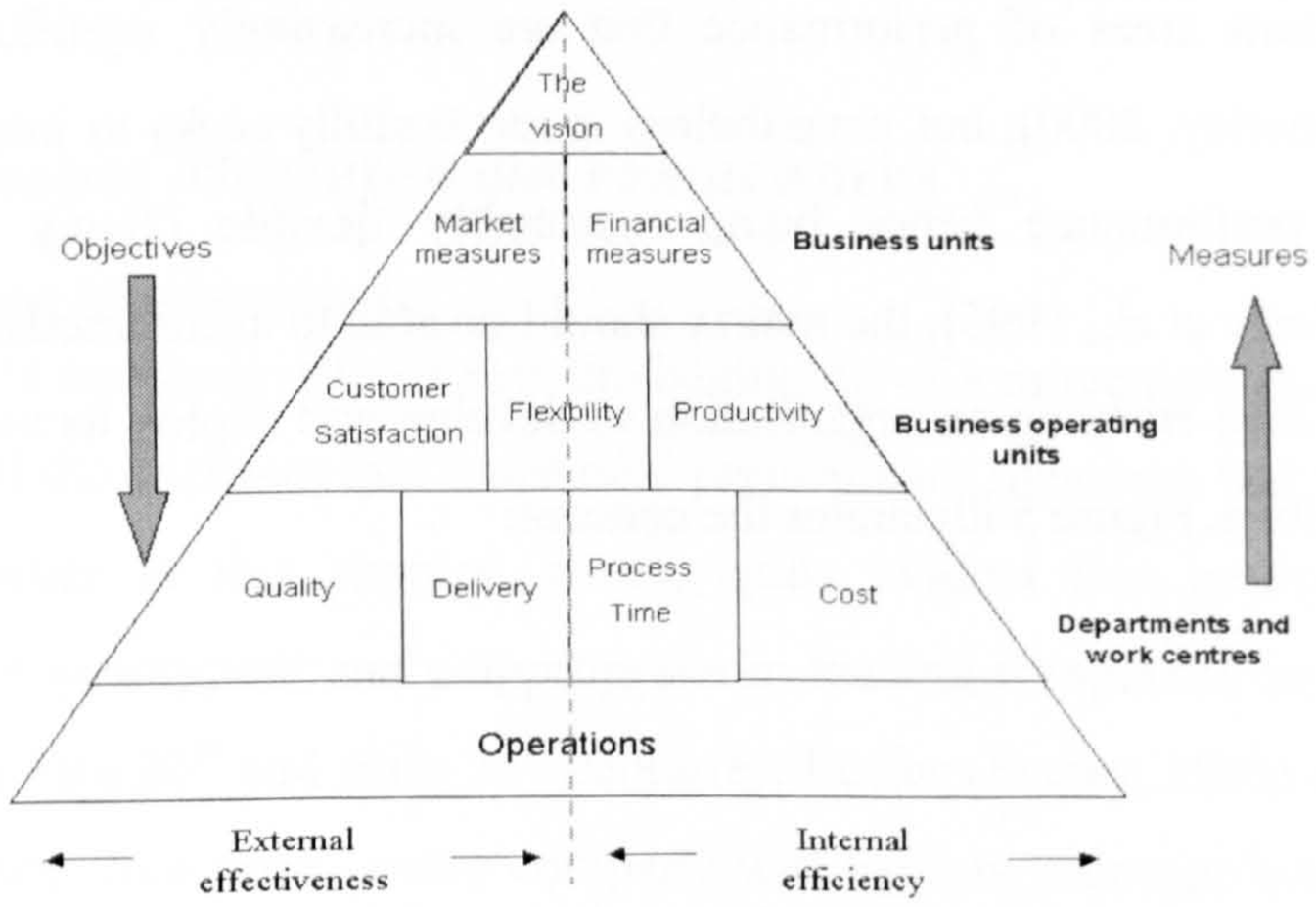


Figure 6 The performance pyramid (Cross and Lynch, 1988-1989)

The performance measurement pyramid supports the concept of cascading measures throughout the organisation so that departments and work centres can reflect the corporate vision through their operations. The top level of the pyramid represents the company's vision or strategy. From this level roles are assigned to each business units by management, and resources are allocated to support them. Onto the second level, the objectives for each business unit are deployed in terms of financial and market measures.

Another framework proposed by (Fitzgerald, 1991), is the Results and Determinants model (See Figure 7). The framework is based on the authors' study in the service industry and classifies performance measures in two distinct categories. Those that relate to results (competitiveness, financial performance) and those that relate to the determinants of those results (quality, flexibility, resource utilisation and innovation).

	Results		Determinants			
Dimensions	Competitiveness	Financial	Resource Utilisation	Quality of Service	Flexibility	Innovation
Type of Measure	Relative market share and position, Sales growth	Profitability Liquidity Capital structure, Market ratios	Productivity Efficiency Utilisation	Reliability, Responsiveness Comfort, Aesthetics/ Appearance, Friendliness, Cleanliness/ Tidiness, Communication, Courtesy, Competence, Access, Availability, Security	Volume flexibility, Delivery flexibility, Specification	Proportion of old and new product/ services, New product/ Service sales

Figure 7 The results and determinants model (Fitzgerald, 1991)

This model supports the concept of causality as it clearly relates the need to identify performance drivers to desired results, through appropriate measures. The concept of causality is investigated further by Brown, through the use of cause and effect relationships (Brown, 1996). The main assumption underpinning this framework is that operations produce goods and services through their processes (Neely, 1998). In his Macro Process

Model of the Organisation (See Figure 8), Brown illustrates explicit links between five stages in a business process, and the relevant performance measures.

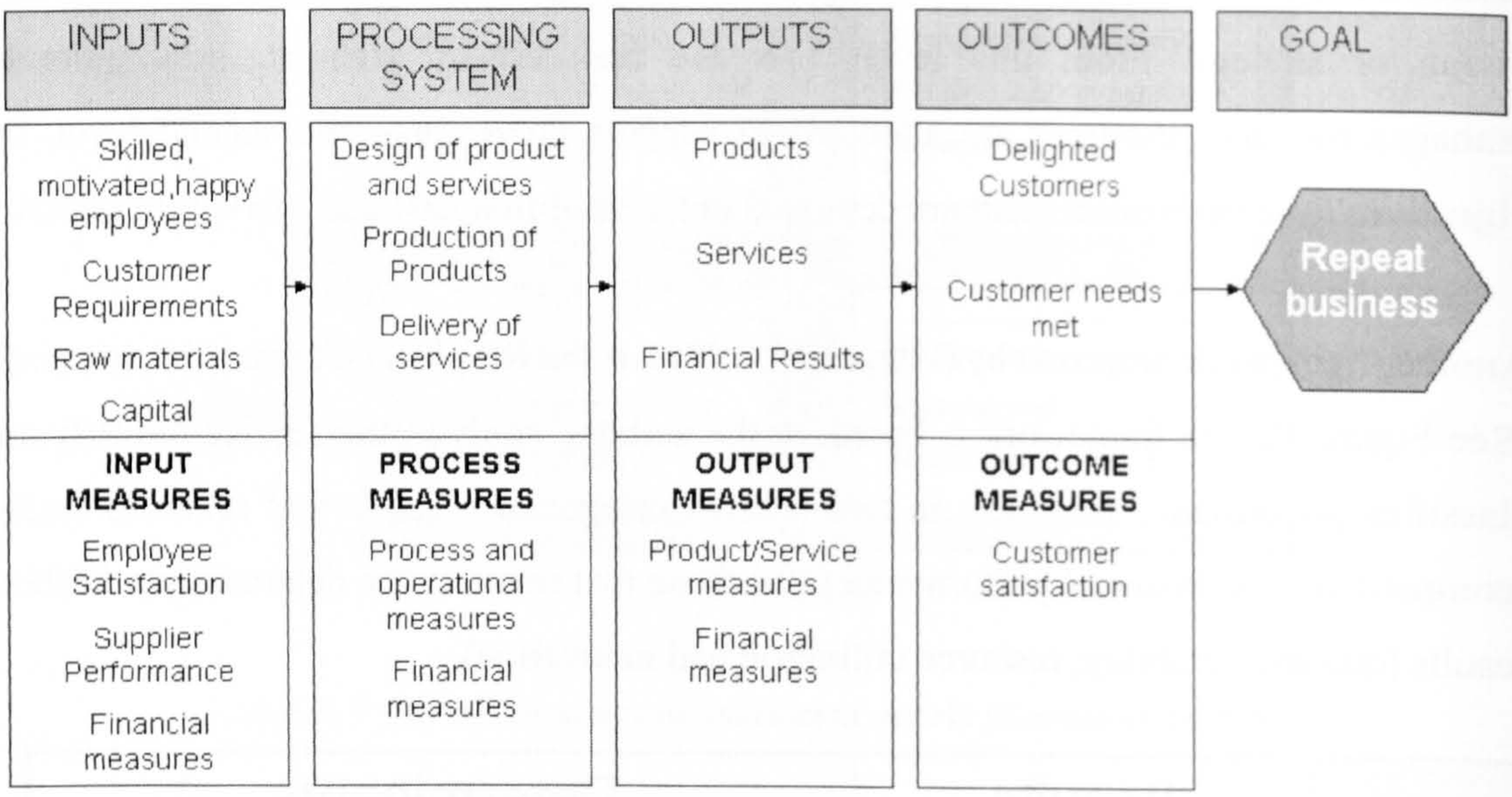


Figure 8 Brown's model of process measures (Brown, 1996)

Brown's model implies that processes are best evaluated using input, process, output and outcome measures. The example given in Brown's model is the process of baking. For example, input measures for this process would be the quality and quantity of the ingredients, i.e. flour, water etc. and process measures would be the period and temperature of the baking. Output measures would be the quality of the product in terms of the process, i.e. has it risen? Is it golden? and outcome measures would relate to customer satisfaction, i.e. Is it tasty? Does it satisfy the customer?. In Brown's model a goal would relate to long-term objectives. In this example, that would be to sustain the customer satisfaction needed to sustain business, i.e. keep baking good cakes according to customer requirements. The main advantage of this approach is that it forces the parties responsible for assessing the performance of the business to look at processes at a micro level (Neely, 1998) thus making it more operationally relevant. It should be possible to apply Brown's model in any organisation.

Arguably the most successful and popular performance measurement framework is Kaplan and Norton's Balanced Scorecard (Kaplan and Norton, 1992; Kaplan and Norton, 1993;

Kaplan, 1994; Kaplan, 1996; Kaplan, 1996a; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c). The Balanced Scorecard is illustrated in Figure 9. The Balanced Scorecard is based on the principle that a performance measurement system should provide managers with enough information to answer the following questions (Neely et al., 1995):

- How do we look to our shareholders? (Financial perspective)
- What must we excel at? (Internal business perspective)
- How do our customers see us? (Customer perspective)
- How can we continue to improve and create value? (Innovation and learning perspective)

The Balanced Scorecard is a management tool that identifies the relationships between financial and operational measures and emphasises the need to balance them. Its main purpose is to give managers a comprehensive view of their company's performance through different interrelated perspectives. One of the assumptions underpinning the Balanced Scorecard is that a company's strategy can be translated into a set of cause and effect relationships.

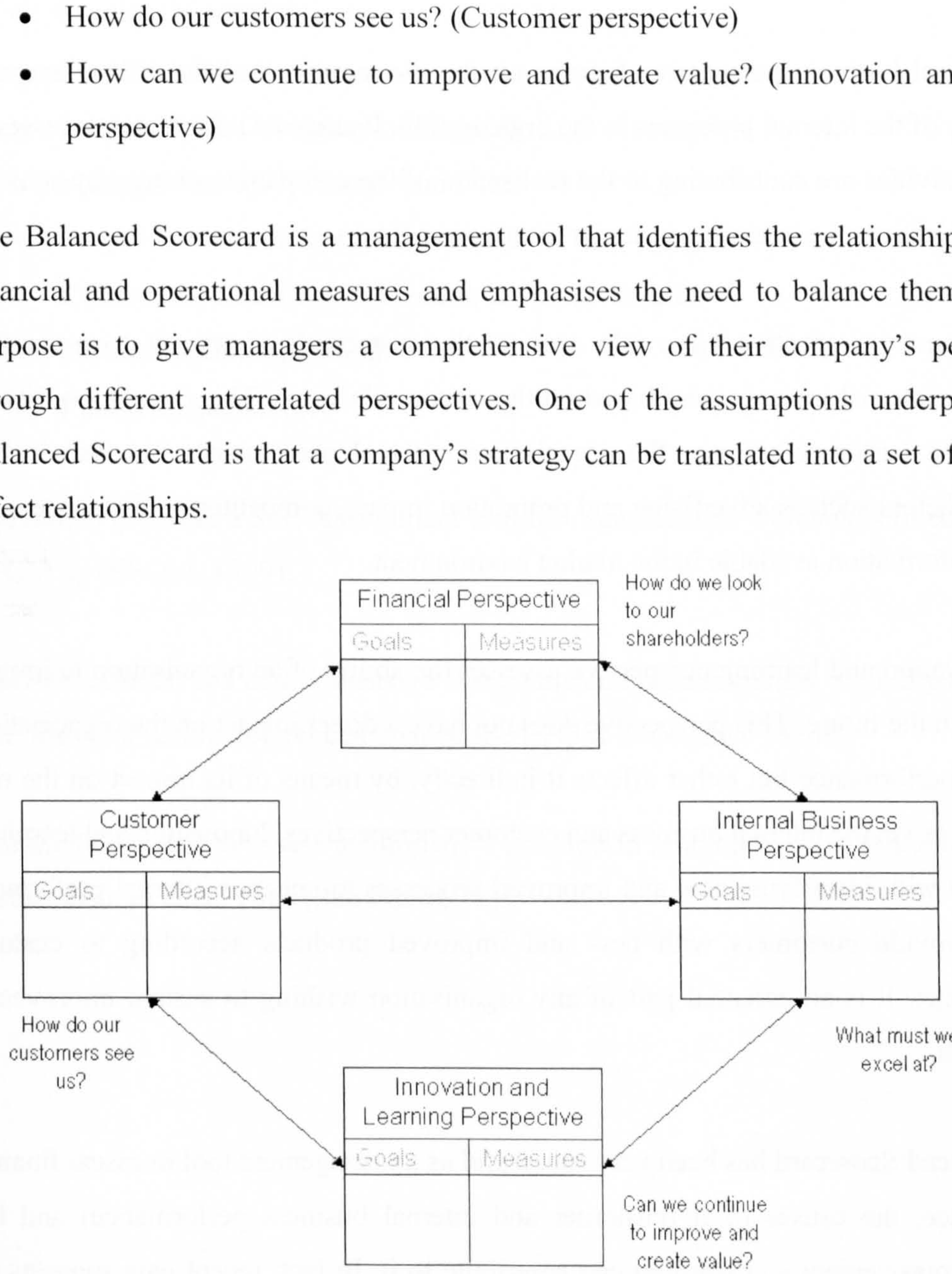


Figure 9 The Balanced Scorecard (Kaplan and Norton, 1992)

The financial perspective's main goal is the translating of the company's mission and strategy into a set of financial key objectives. It relates most closely to the traditional financial measures of performance, assessing how shareholders value the company. Again, it supports the notion that financial measures will always be important, as financial performance is the ultimate goal of any organisation. A generic set of financial objectives in this perspective includes measures related to income increase, cost reduction, productivity improvement, and asset usage.

The internal business perspective focuses on the measurement of the effectiveness and efficiency of the internal processes in the organisation. It assesses how these processes and related activities are contributing to the realisation of the companies strategy by achieving certain objectives, i.e. increase customer satisfaction etc.

The customer perspective takes into account the customer's viewpoint so as to focus efforts for internal improvement based on the customer's voice. This does not only relate to how the customer assesses the organisation's actual performance but also includes external factors such as advertising and promotion impact, competitor performance and in general information available in the market environment.

The innovation and learning perspective assesses the ability of an organisation to improve now and in the future. This perspective does not have a direct impact on the organisation's financial performance but rather affects it indirectly, by means of its impact on the other perspectives i.e. the internal business and customer perspectives. Innovation and learning is concerned with identifying new and improved processes to enhance internal performance and to provide customers with new and improved products according to customer requirements. It is an essential part of any organisation wishing to sustain improvement and growth.

The Balanced Scorecard has been very successful as a management tool to assess financial performance, the causes of it (customer and internal business performance) and how ongoing improvement and learning can contribute to it. In fact, recent data suggests that between 40% and 60% of large US firms would have adopted the Balanced Scorecard by

the end of 2000 (Frigo and Krumwiede, 1999). All four perspectives in the Balanced Scorecard are given equal weighting ensuring that management take into consideration not just the desired end results, but also the interaction between the perspectives.

The EFQM (European Foundation for Quality Management) Excellence Model is a management tool that encompasses eight fundamental concepts of excellence.

- Results Orientation
- Customer Focus
- Leadership & Constancy of Purpose
- Management by Processes and Facts
- People Development & Involvement
- Continuous Learning, Innovation & Improvement
- Partnership Development
- Public Responsibility

The model provides a Self-Assessment tool for organisations which is defined by the EFQM as (EFQM, 1999):

"Self-assessment is a comprehensive systematic and regular review of an organisation's activities and results referenced against the EFQM Excellence Model."

The model is used to assess a company's position in relation to each of the nine criteria on the route to excellence (See Figure 10).

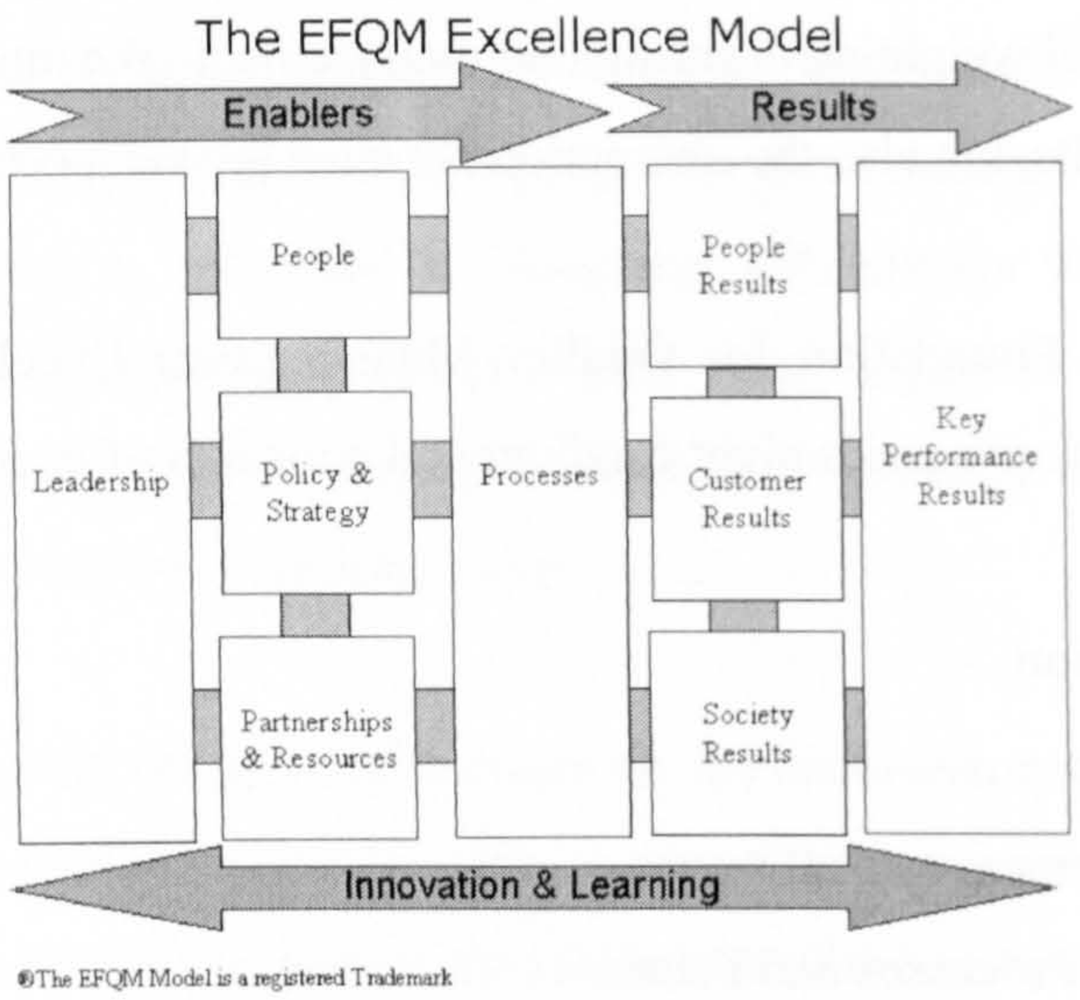


Figure 10 The EFQM Excellence Model

The EFQM Excellence model assesses how leadership, policy and strategy, partnerships and resources and people and processes (enablers) are being used in order to achieve people, customer, society and key performance results (results). As a result there is an underlying implicit cause and effect chain that can be used to examine indicator interrelationships. These indicators can be derived from the different criteria of the model and the EFQM itself does provide with a few suggested indicators as a guideline. The results criteria of the model (People Results, Customer Results, Society Results and Key Performance Results) have been used as a performance measurement framework since it provides four different perspectives, from which relevant performance measures can be derived.

The most recent of the performance measurement frameworks is the Performance Prism (Neely and Adams, 2000) which was developed at Cranfield University's Centre for Business Performance, to address the need for "..a multi-faceted, highly flexible and adaptable framework, that would address the needs for business performance measurement within the new competitive environment of the 21st century..". Figure 11 illustrates the Performance Prism.

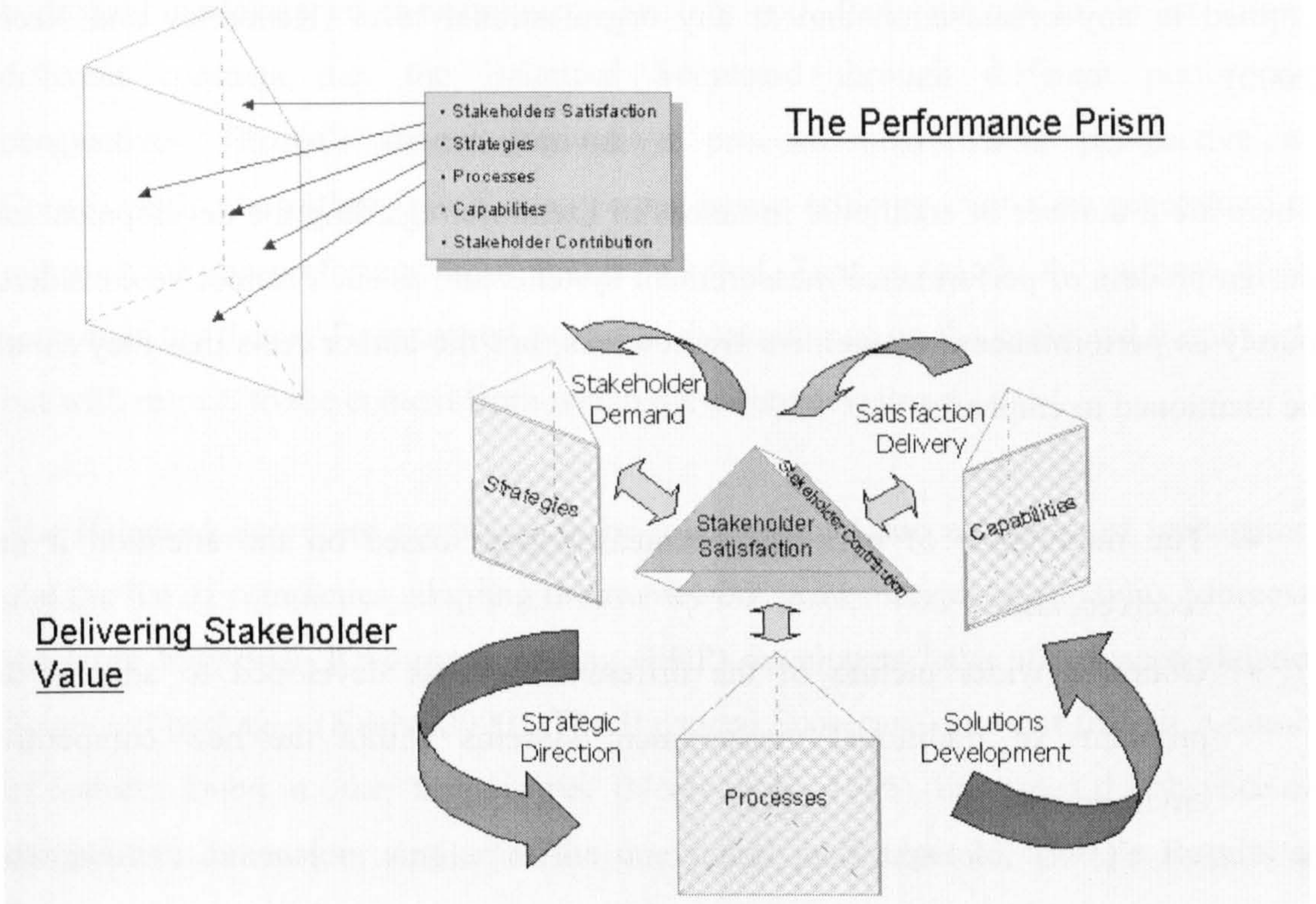


Figure 11 The Performance Prism and its facets (Neely and Adams, 2000)

The Performance Prism's five linked perspectives seek to answer five basic questions when assessing a company's performance (Kennerley and Neely, 2000):

1. *Customer Satisfaction* – who are our key stakeholders and what do they need?
2. *Strategies* – what strategies do we need to put in place to satisfy the wants and needs of these stakeholders?
3. *Processes* – what critical processes do we require if we are to execute these strategies?
4. *Capabilities* – what capabilities do we need to operate and enhance these processes?
5. *Stakeholder contribution* – what contributions do we require from our stakeholders if we are to maintain and develop these capabilities?

The answer to these logically linked questions demonstrates the creation of stakeholder value as depicted in Figure 10. The main advantages of the performance prism are that it is a truly comprehensive and balanced framework that according to the authors can be

applied in any organisation and at any organisational level (Kennerley and Neely, 2000).

There are a number of additional instances in literature regarding the development and design process of performance measurement systems and as such cannot be considered purely as performance measurement frameworks, but the author feels that they should be mentioned to emphasise:

- The importance of performance measurement based on the attention it has received, and
- Obtain a wider picture of the different methods developed to address the problems of traditional measurement systems within the new competitive environments.

The most popular methodologies for the design of a performance measurement system are the Cambridge process (Neely, 1996), and the Integrated Performance Measurement System (IPMS) reference model (Bititci et al., 1997). Both methodologies provide a balanced view of performance through measures derived by strategic objectives. Their main difference lies in their deployment, the Cambridge model mainly concentrates on the design, review and implementation stages of the performance measurement process, whereas the IPMS methodology mainly concentrates on how it should be operated (Bititci et al., 2000). Another methodology worth mentioning is the Performance Measurement Questionnaire (PMQ) developed by Dixon et al. (Dixon et al., 1990) which is a structured methodology for auditing whether a company's performance measurement system encourages continuous improvement (Neely et al., 1995). Finally, the Integrated Manufacturing Model (IMM), as the name suggests is mostly appropriate to a manufacturing environment and is a performance measurement system design methodology focusing mainly on implementation issues.

2.5.3 Frameworks in their Context

All the frameworks presented earlier share a common purpose that led to their development: They all attempt to address – in one way or another – the shortcomings of

traditional performance measurement. To this end, they attempt to do so through different contexts, i.e. the Balanced Scorecard through different performance perspectives, Brown's model through a process measurement perspective etc. Consequently, the author feels that any constructive criticism cannot be generalised but rather should be performed bearing this in mind. That is exactly the purpose of this section of the thesis: To report on potential shortcomings on the presented frameworks, but with respect to the context from which they were developed.

The Balanced Scorecard continues to be a commercial success amongst management and the list of companies adopting the framework grows longer all the time. Moreover, the large Enterprise Resource Planning (ERP) developers have all released Balanced Scorecard packages (Neely, 2000). The Balanced Scorecard does not include a number of features found in other frameworks. (Neely et al., 1995), has noted the absence of a competitive dimension, similar to the one found in (Fitzgerald, 1991)'s Results and Determinants model. Moreover, the Balanced Scorecard provides little support or guidelines as far as the process of performance measurement system design is concerned (Neely et al., 1995). Other authors (Ghalayini and Noble, 1996), support that the Balanced Scorecard is more suitable to senior managers, and consequently is not suitable to factory level. (Gregory, 1993), states that it would require additional effort to go much lower than the level the Balanced Scorecard is designed to operate in. (Kennerley, 2000), makes the point that, the naming of the financial perspective limits the applicability of the framework. For instance, in organisations where profit is not important, such as charities or certain public sector institutions, an alternative name that would refer to 'business results', would be more appropriate. Another criticism of the Balanced Scorecard is that it does not reflect different dimensions of performance as the SMART pyramid or the Results and Determinants model (Kennerley, 2000). A valid observation also made by (Kennerley, 2000), is that neither the customer nor the internal business perspective are defined in terms of the dimensions of performance that determine success such as the earlier mentioned strategic objectives of quality, cost, time and flexibility. As (Keegan et al., 1989)'s performance measurement matrix clearly demonstrates, there is a need to have both external and internal measures of these competitive priorities. To illustrate this point, it would be possible for a car

manufacturer to say, produce a car to customer requirements after a series of inspections and rework, but that would incur extra costs. Such actions, would not produce sustained business results, hence there is a need for every customer measure to be supported by a corresponding internal one, to achieve maximum benefits. Another drawback of the Balanced Scorecard is the absence of any mention of suppliers (Neely, 1998).

Brown's Macro Process Model of an Organisation (Brown, 1996) implies that having control over the performance of one of the described stages, will result in establishing the ability to predict the performance of the organisation at the next stage. Brown suggests that if all your processes (process system) are under control, then for the same input the outputs will always be the same. This argument can be extended further to other stages in the framework. For instance, if all the outputs at each stage can be controlled, and it is collectively understood how they combine to produce the desired outcomes, then the outcomes become predictable (Kennerley, 2000). Realistically, in a business environment there are a number of factors, and a high degree of uncertainty that can affect this predictability, but nevertheless the previous argument suggests that measurement of operational processes can help predict performance higher up in the organisation. This suggestion is quite relevant to support one of the main themes of the current research.

Keegan's performance measurement matrix (Keegan et al., 1989) definitely reflects the theme of comprehensiveness, as it is possible to map all of an organisation's measures onto the framework. This process of mapping the measures can help a company identify possible gaps and or areas that need tighter focus. Nevertheless, the performance measurement matrix provides little guidelines as to the different dimensions of performance that should be measured.

The Results and Determinants model (Fitzgerald, 1991) clearly supports the notion of causality and suggests that results are a function of performance drivers (determinants). This notion demonstrates the need to measure both results and their drivers so that past performance can be analysed to affect future performance. Nevertheless, the model does

not explicitly support the cascading of measures throughout the organisational hierarchy, and neither does it clearly support the concept of continuous improvement.

The SMART model developed by Wang Laboratories (Lynch and Cross, 1991) also supports the notion of including internal and external measures of performance. It explicitly depicts the concept of cascading the measures throughout the organisation as well as internal and external business unit objectives. Nevertheless, one of the main weaknesses of the SMART model is that it fails to provide an effective mechanism for identifying key performance measures for quality, cost, time and delivery (Ghalayini and Noble, 1996). Moreover, it does not explicitly integrate the concept of continuous improvement.

The Performance Measurement Questionnaire (PMQ) although providing a mechanism for identifying areas for improvement within the company, cannot be considered a performance measurement framework. Nevertheless, it does attempt to assess whether the company's exiting performance measurement system supports such improvement areas. On the other hand, a main drawback of the PMQ is that it does not go all the way to linking these areas of improvement and performance measures to the shop floor (Ghalayini and Noble, 1996). Moreover, it does not take into account the concept of continuous improvement.

The EFQM Excellence Model is a true multidimensional framework that provides one of the broadest scopes of performance dimensions to be measured. It also implicitly integrates the concept of causality through how enablers can achieve results. Nevertheless, the EFQM Excellence model has a major weakness in that, although the results criteria are reasonably easy to measure, the same does not apply to certain enablers (Neely et al., 1995). The EFQM Excellence Model and the Balanced Scorecard have been the most successful frameworks in each side of the Atlantic respectively. In a common interest seminar held at the EFQM headquarters (8/12/99), the main differences and the positioning or possible combination of each framework were presented. Figure 12 illustrates the main points and how the two models can be used in a performance improvement context.

Balanced Scorecard	EFQM Excellence Model
•Context dependent	•Context independent
•Prescriptive and focused	•Descriptive and comprehensive
•Hypothesis driven and subjective	•Fact based and objective
•Where do we want to go?	•Where are we now?
•Explicit cause and effect model	•Implicit cause and effect model
•External variables are not systematically addressed	•External variables systematically addressed

Comparing the EFQM Excellence model and the Balanced Scorecard

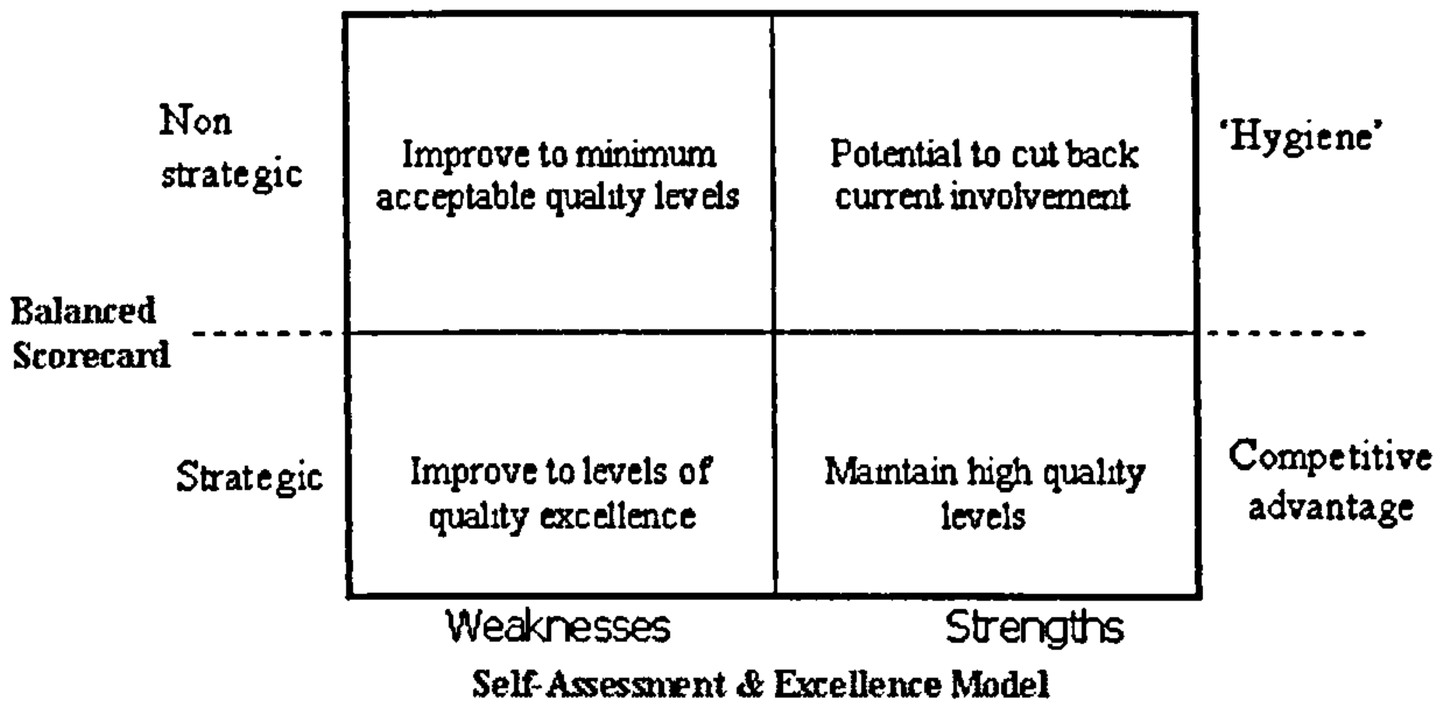


Figure 12 Comparison between the EFQM Excellence model and the Balanced Scorecard (Carter and Lamotte, 1999)

The investigation into performance measurement frameworks provides the essential background information for a deeper understanding of the issues of performance measurement in the current business environment. The frameworks are used as management tools by organisations to help them identify and deploy appropriate performance measures. Amongst others, they raise issues such as the need to measure financial and non-financial performance as well as establishing the need for external and internal measures of performance. Furthermore, there is a growing theme amongst performance measurement frameworks to measure drivers of performance. To summarise, current frameworks have displayed a number of key characteristics:

- Comprehensive
- Multi-Dimensional
- Balanced
- Accurate and to the point
- Integrated
- Measuring drivers of performance

Examples of implementation of the above frameworks can be found in literature, but until recently there has been little research into their effectiveness, and the cause and effect relationships underpinning them. The frameworks presented provide different views on performance measurement, but mainly concentrate at the corporate level. It has been suggested (Neely et al., 1995; Bititci et al., 1997) that one of the main characteristics of a successful performance measurement system should be horizontal and vertical integration. However, there have been very few instances of such an implementation in practice. Brown's process measurement model goes one step further by clearly suggesting that low level inputs should be linked to the organisation and in turn to its goals. This suggestion is relevant to the research since to link those low-level inputs, one has to investigate the factors that affect them, to gain a deeper understanding of their relationship.

2.5.4 Universal Frameworks?

There are an abundance of performance measurement frameworks that have been developed to address the shortcomings of traditional performance measures. Each of the frameworks claims to be unique and address performance measurement issues through a unique perspective. In certain cases many of the frameworks seem to conflict with each other. Moreover, all claim to be comprehensive and include issues not addressed by others. The key to understanding this phenomenon lies in understanding the diversity and complexity of modern business. The modern competitive environment is a field dominated by rapid changes dictated largely by the customer. All the above frameworks seek to equip businesses with the appropriate tools to face those changes. Depending on the context and the specific circumstances, each framework is indeed unique and all of them add value (Neely and Adams, 2000). Each unique approach to performance measurement employed by a specific framework might be more appropriate to one company than another, and again might be appropriate for the same company at a specific moment in time only. There is no universal solution, whether called methodology or framework, that can accurately represent the dynamic nature of a business. Performance can be viewed in different ways and each of the frameworks represents one of them.

It is interesting to note that in cases where the frameworks include different performance perspectives – to achieve balance – the question arising is: Does this limit its

flexibility/applicability? Indeed, one must observe that while all frameworks strive to be comprehensive and include all possible measures, sometimes that is not the case. Take the Balanced Scorecard for example, there is no explicit perspective that takes into account the competition or indeed the supplier. Does that make the application of the framework somewhat limited? If the framework is applied off-the-shelf, as mentioned earlier under certain circumstances, then probably yes, but the real answer to this question was demonstrated in the seminar held at the EFQM headquarters in Brussels (8/12/99). The aim of the seminar was to share experiences amongst companies using the EFQM Excellence Model and the Balanced Scorecard, two seemingly different and sometimes conflicting frameworks (See Figure 11). The companies invited were mainly multi-national global companies that were quite familiar with the concept of performance measurement. The main theme that was raised during that seminar was integration. The companies were actually using both models together and on top of that they had actually modified them (i.e. added another perspective to the Balanced Scorecard) to make them more suitable to their needs. It became obvious that a lot of the criticism addressed to either model was actually overcome by companies applying their business logic to suit their circumstances. What this really demonstrates is that indeed there is "….no holy grail" (Neely and Adams, 2000), when it comes to performance measurement frameworks. As such, one of the main concerns when choosing a performance measurement framework should be whether the framework meets or is capable of meeting the company's needs in an effective manner.

2.6 Cause and Effect Relationships in Performance Measurement

The study of performance measurement frameworks in the previous section, underlines a central concept of this research, by highlighting the identification of cause and effect relationships regarding a company's performance. It also supports the need to understand the factors that affect that performance. Frameworks such as the Balanced Scorecard, the Results and Determinants framework and Brown's Process Model, all support the notion that low-level areas of an organisation can be linked to strategic objectives and plans. Brown's model as was discussed in section 2.5.2, does so explicitly by establishing a link between inputs of the organisation to its goals via processes, outputs and outcomes. Although in the context of performance measurement this concept is relatively novel, it has

been used before in the context of the cost of quality as seen in section 2.3.3. The analogy would be that in order to establish whether the investment in prevention costs (input measure) has been effective one would have to simultaneously monitor failure costs (output measures). Kaplan and Norton's Balanced Scorecard (discussed in section 2.5.2) similarly, forces management to view all their operational measures together to prevent sub-optimisation of performance (Kaplan and Norton, 1992).

Brown's model suggests that there is a need to fully understand the cause and effect relationships between factors and measures. It also implies that fully understanding the factors affecting a performance measure can lead to an insight in the way it will perform in the future. This concept is not so dissimilar to certain tools used in quality control, such as Statistical Process Control (SPC) where a pattern in the process output can give an indication of its progress and consequently whether corrective intervention is needed or not.

The factors that can affect performance measures have been a key theme in academic and business research (Beischel and Smith, 1991; Wisner and Fawcett, 1991; Johnson, 1992; Kennerley et al., 1996; Kaplan, 1996a; Kaplan and Norton, 1996b). Most of these authors identified the need to understand how these factors might affect performance measures, in the form of a structured hierarchical framework that would accommodate these links. This notion can be expanded to include the use of tools that have been used in the past to identify factors affecting a variable, such as the Quality Function Deployment (QFD) Matrix, or the cause and effect or Ishikawa or fishbone diagram widely used to "… systematically analyse cause and effect relationships and identify potential root causes …."(BSI, 1992). The Ishikawa diagram was first developed to assist in the identification of quality defects (Ishikawa, 1990), and is extremely helpful when organising thoughts about causes of variation. Kaplan and Norton developed a framework based on this underlying concept (Kaplan and Norton, 1996b; Kaplan and Norton, 1996c) where strategic measures of performance have been linked to drivers of performance based on a large number of case studies.

There have been instances of performance measurement systems that were implemented with their cause and effect relationships directly providing an input to the management process. The level of implementation maturity varies from simple variable correlation (Jeanes, 1996) to a full scale quantified interrelated performance measurement (Rucci et al., 1998). In most of the cases the goal of such an approach is the understanding of how through causality companies can improve their operations and results. There is active interest in the study of cause and effect relationships between measures and drivers of performance and consequently real value in understanding them and including them in the management process. Instances can be found in both the service (Schneider et al., 1980; Schneider, 1990; Burke et al., 1992; Johnson, 1996) and the manufacturing sector (Kaplan and Norton, 1992; Jeanes, 1996). Rucci et al, (Rucci et al., 1998) discuss the application of a model similar to the 'service profit chain' model (Heskett et al., 1997), to Sears, Roebuck and Company, where the organisation managed to establish quantitative relationships between employee satisfaction, customer satisfaction and financial results. Their model established that a 5-point improvement in employee attitude will result to a 1.3 point improvement in customer satisfaction, which will result in a 0.5% improvement in revenue growth. There have been also other instances of authors working on relationships between performance measures but mainly concentrating on their design (Flapper et al., 1996).

Despite these efforts, no generic framework that links performance measures at different organisational levels has been developed to facilitate performance improvement. Moreover, most of the work carried out has focused on cause and effect relationships between measures and little work has been done on the actions that these measures might initiate. This gap identified clearly relates to Section 2.2.3 where several of the guidelines for the design of effective performance measures relate to improvement support and action initiation (Maskell, 1989; Neely et al., 1995).

One of the most significant attempts to develop cause and effect relationships in the field of manufacturing management has been the work regarding the development of the Production System Variable Connectance model (Burbridge, 1984a; Burbridge, 1984b). Burbridge's work focused on linking variables related to production systems to each other. The assumption underpinning the concept was that a change in a variable would result in a

subsequent change to one or more variables that it was related to. The suggested framework provided a generic set of qualitative cause and effect relationships linking variables within the production system. One of the most important issues related to Burbridge's work was that he did not consider it possible to state quantitative relationships between variables, without relating them to the way the system was designed. The implication of this notion is that the author recognised the complexity of a production system and also that cause and effect relationships are not only a function of the variables but also of the system. Burbridge's model was mainly used as a tool to assist managers in the management of production systems. Although the work of Burbridge was undertaken almost twenty years ago it does represent a significant step in drawing attention to the interaction of factors at all levels of an organisation. The main inputs to the development of the model were Burbridge's extensive experience of production models and expertise, and consequently, it was more of an engineering approach to developing a model to assist production management. One major drawback of the model is that it mostly relates its outcomes to only financial measures. This relates to the fact that at the time of its development, there had been no work identifying the need for focus on non-financial measures in an organisation.

A significant step expanding on Burbridge's work was taken by the work of Kennerley (Kennerley et al., 1996; Kennerley et al., 1996; Kennerley, 2000). Based on a large proportion on Burbridge's work the author developed a framework of performance measures within Manufacturing Planning and Control (MPC) Systems. The framework included measures and relevant variables that affect them and went one step further by relating these to financial and non-financial measures of performance. Kennerley's model also related these variables to a version of the four competitive priorities that were mentioned in Section 2.3.3 i.e. Quality, Cost, Delivery, Flexibility. The model also included relationships between variables affecting performance and practices derived from World Class Manufacturing literature. However, the model does little to examine how performance improvement can be achieved realistically using it since it does not incorporate any decision-making mechanisms. Furthermore, it does attempt to link performance measures to best practices found in literature, a task that in some cases is both unrealistic and inappropriate.

There have been other instances in literature regarding cause and effect relationships in performance measurement and the factors can affect performance. Work based on production models by (Bititci, 1995), identified factors that can influence a specific performance measure. Expanding on that concept, there has been a reasonable amount of work done in that specific area by using the Analytical Hierarchy Process (AHP) first developed by Professor Saaty (Saaty, 1980). The Analytical Hierarchy Process is a multi-attribute decision technique that uses pair wise comparisons to assign weights to factors through a scoring system. The technique develops a hierarchical structure of the decision problem, however it is quite complicated and does suffer from the phenomenon of 'rank reversal' where the model is unable to deal with added or removed decision alternatives (factors). This directly opposes the dynamic nature of performance measurement. Applications of the AHP can be found in several instances ranging from a single performance measure (Suwignjo et al., 1997) to comparing performance of manufacturing departments (Rangone, 1996).

Attention has been drawn in literature regarding the analysis and understanding of the factors that affect performance. It has become clear that the management of factors that affect performance can have a positive impact on the overall management of an organisation. There have been case studies (Tempest, 1998), demonstrating the benefits of such an approach, and the number of publications on the subject seems to increase all the time. To this end, although the advantages of linking performance measures to their performance drivers at all levels within an organisation has be identified, with the exception of Burbridge and Kennerley, very little has been undertaken to define cause and effect relationships regarding business performance.

2.7 Performance Improvement

2.7.1 Introducing Improvement

As discussed in Section 2.2.4, one of the key characteristics of a successful performance measurement system is that it should actively support improvement. Indeed, one can argue that the ultimate goal of performance measurement is performance improvement. Performance improvement has arguably been at the heart of organisational strategies; indeed, the mission and vision statement of a company can be seen as a trigger for

improvement. This section will discuss the concept of performance improvement and also elaborate on its use within performance measurement and its relationship to continuous improvement.

2.7.2 Organisational Improvement

It has been established that the improvement of internal and external performance is an essential goal of any organisation that actively seeks to be competitive and successful (See section 2.3.2). Speaking generically, there are three types of commonly used methods to improve performance and grow:

- Asset Management – The buying and selling of assets with the purpose of achieving one or many of the following:
    a. A better product portfolio
    b. Synergies between operations
    c. Economies of scale
    d. Increased market share
    e. New marketing opportunities
    f. Release funds
- New technology products – The creation of completely new technological products and markets.
- Process improvement – Initiatives improving one or more aspect of the business.

2.7.2.1 Business Process Re-engineering

The above methods can be used individually or as a continuous process and imply the need for change in an organisation. Indeed, change is the only constant in today's business environment (Chase and Aquilano, 1995). In fact, the 1990's were the decade of radical change as businesses around the world began to realise that they are "entering the twenty first century with companies designed during the nineteenth century to work well in the twentieth" (Hammer and Champy, 1993). Many organisations addressed the need to remain or become competitive through dramatic improvements in quality, costs, time, and customer service. One of the ways companies achieved that was by 'reinventing' themselves by organising work around processes. The focus had shifted away from functional to a holistic view of an organisation. Such change was being done

through process and organisational innovation as well as through creative application of information technology (Chase and Aquilano, 1995; Caudle, 1997). Consequently, the concept of improving the business through Business Process Reengineering (BPR) emerged, headed by Mike Hammer (Hammer, 1990). He defines reengineering as the "fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as quality, cost, service and speed" (Hammer and Champy, 1993). Reengineering has been around for over twenty years and many manufacturing organisations have been at its forefront without realising it. They have implemented, concurrent engineering, lean production, cellular manufacturing, group technology and pull-type production systems, all of which represent radical rethinking of the manufacturing process. Reengineering is about achieving a significant improvement in processes so that contemporary customer requirements of quality, speed, innovation, customisation and service are met. At the heart of this concept, is the elimination of non-value adding activities.

2.7.2.2 Continuous Improvement and Quality Control Circles

Another concept that has played a major role in a business environment over the last thirty years is quality. With the advent of advanced quality management philosophies such as TQM and Continuous Improvement (CI), improving performance through quality improvement was an area of very active interest. W.E. Deming was at the core of the development of the concept of quality improvement with his now famous Plan-Do-Check-Act cycle (See Figure 13)

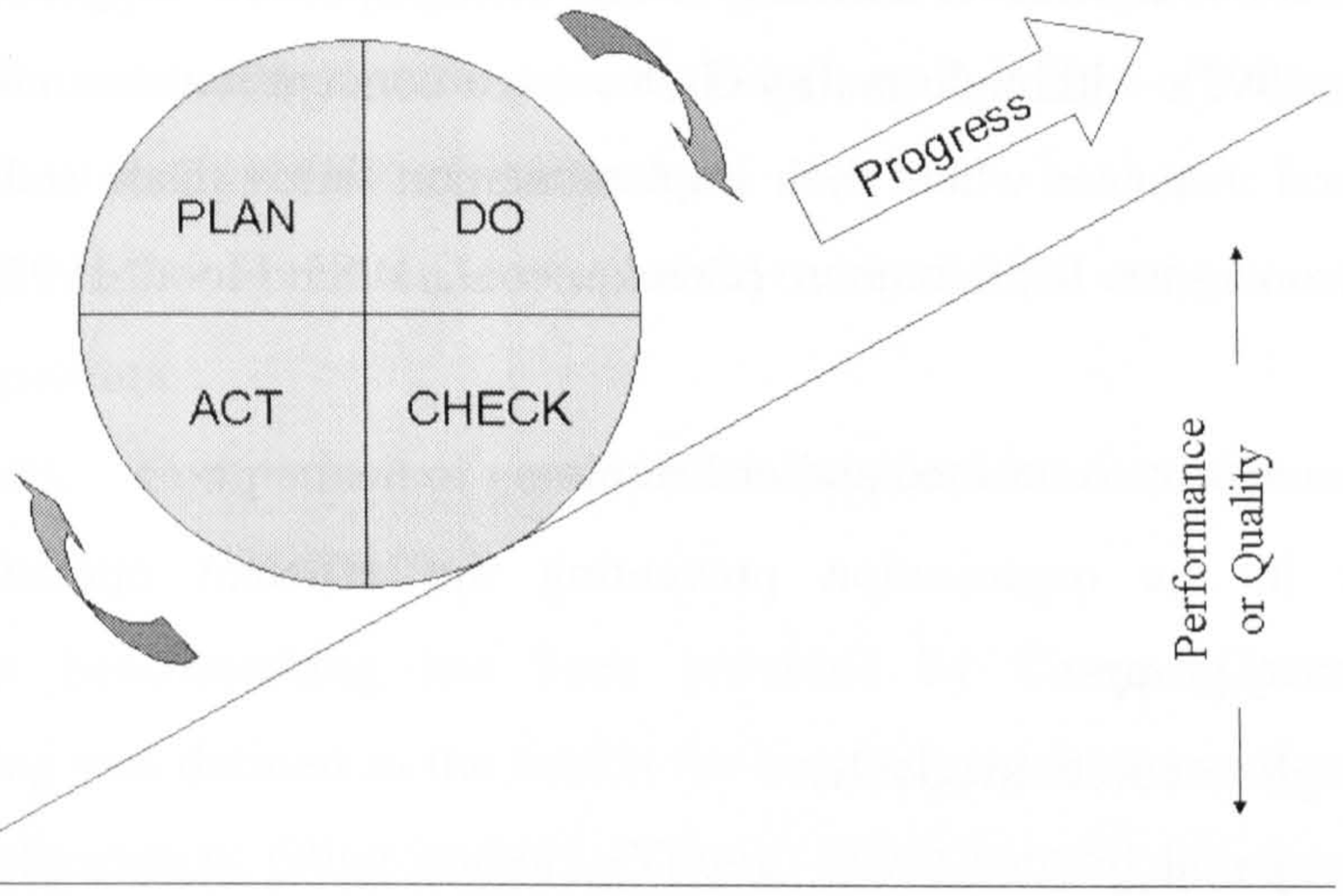


Figure 13 The Deming PDCA cycle

(Fortuin, 1988), gives his view on the steps in Deming's wheel:

Plan - Make plans to improve an activity
Do – Carry out these plans
Check – Look at the results; compare actual with desired performance
Act – Consolidate the measures that proved successful

As illustrated in Figure 12, the concept of ever-improving performance is at the heart of Deming's wheel. Indeed, this concept is very much the epicentre of Continuous Improvement (CI). Continuous Improvement is a management philosophy that approaches the challenge of product and process improvement, as a never-ending process of achieving small wins (Chase and Aquilano, 1995). It forms an integral part of Total Quality Management. Specifically, Continuous Improvement seeks continual improvement of resources, materials, labour and methods through application of suggestions and ideas of team members. One of the ways of achieving this, collective channelling of ideas for improvement has been Quality Control Circles (QCC). QCC's are essentially formed by a small number of volunteer workers that meet on a regular basis to discuss how their tasks can be improved effectively and efficiently. One of the main considerations regarding the success or failure of QC programmes is that

management must be responsive, listening to and acting upon the suggestions being put forward (Flood, 1993). Although quality circles are a concept with sound foundations, there been several instances where their implementation failed (Dale and Lees, 1986). Some of the reasons given for failure are (Crocker et al., 1985; Flood, 1993):

- Management not committed and/or listening.
- Conflict in the organisation preventing the efficient operation of open participatory groups.
- Not enough resources available.
- Staff not up to it.

The myths and facts associated with Quality Control Circles have been analysed by Joseph Juran, one of the main gurus of the quality movement (Juran, 1980).

2.7.2.3 Benchmarking

Another tool that can be used within the scope of initiating improvement is benchmarking. A performance measurement system is a function of its individual measures and also the environment that it operates within (See section 2.2.1) . This environment can be assumed to consist of two discreet elements: customers and competitors. As discussed in section 2.5.2 existing performance measurement frameworks can accommodate customer satisfaction and competition measures and there are a number of customer satisfaction measures that can be defined in terms of cost, quality, delivery and flexibility.

Benchmarking takes a more "external" perspective by comparing performance with that of competitors or other best practices or business processes. Indeed, there are four types of benchmarking:

- Internal – Internal to a business, possible comparing business units. Its main advantage is that data is freely available.

- Competitive – Arguable the most beneficial form of benchmarking, comparing direct competitor performance. Data availability of directly comparable information might be very difficult.
- Functional – Functional comparison with similar companies, but not direct competitors.
- Generic – Comparison of generic business processes i.e. sales, order entry etc.

A study in benchmarking has been provided by Camp, (Camp, 1989), where benchmarking was defined as the search for best industry best practices that can lead to superior performance. Other authors (Young, 1993) support benchmarking used as a means of identifying opportunities for improvement. There is extensive literature related to benchmarking (Voss et al., 1992; Voss et al., 1992; Camp, 1995; Zairi and Hutton, 1995; Zairi, 1998), but the process is regarded as a one-off exercise towards generating ideas or gaining commitment to short-term improvement initiatives (Neely and Adams, 2000). However, more closely relating to performance measurement, recent literature (Oge and Dickinson, 1992; Rigas et al., 1999; Bourne et al., 2000) suggests that benchmarking can be used as a tool providing inputs to the ongoing review process of reviewing the performance measurement system.

There are several other tools and techniques that have been and widely used for quality improvement. British Standard BS7850 includes some such as: data collection form, affinity diagram, cause and effect diagram, flow chart, tree diagram, control charts, histogram, pareto diagram, scatter diagram. The potential success of quality improvement projects is usually enhanced by the proper application of these tools and techniques (BSI, 1992). The same concept applies to most methods of organisational improvement.

2.7.3 Directing Improvement through Performance Measurement

Performance improvement is a key element of performance measurement. However, performance measurement on its own does not guarantee performance improvement. There is a need for a closed-loop performance measurement approach where information collected is analysed and acted upon. Many authors have supported this

notion (Oge and Dickinson, 1992; Bititci et al., 1997; Neely et al., 1997; Stoop and Bertrand, 1997; Rigas and Fan, 2000) where it is referred to as performance management. Bititci et al., (Bititci et al., 1997) state that a performance measurement system is an information system at the heart of the performance management process. (Rigas and Fan, 2000), provide a description of the concept, which is based upon Deming's cycle discussed in the previous section. Figure 14 illustrates the concept:

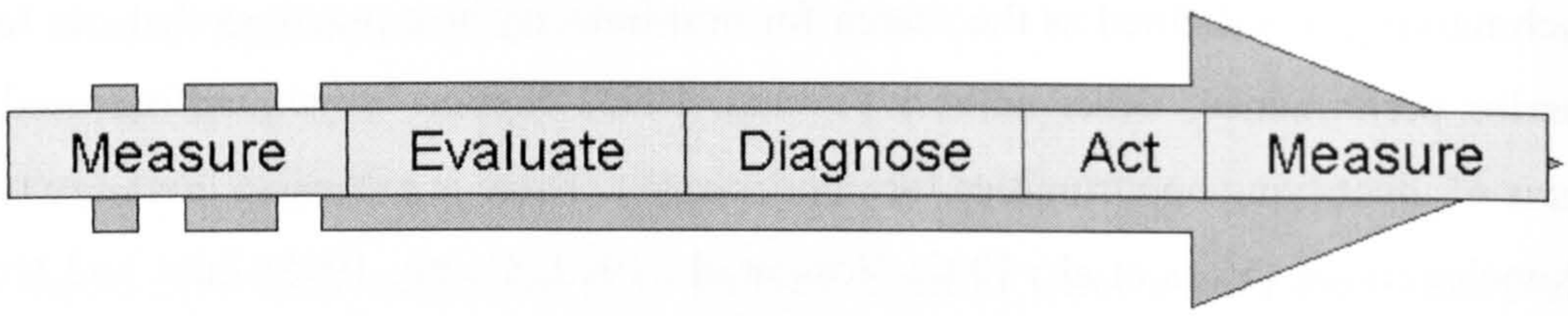


Figure 14 Performance Management

Once measurement (Measure) has taken place, the measured value is compared (Evaluate) against a performance target. After establishing how the performance result was reached (Diagnose), the actions leading (Act) to performance improvements can be taken, and measurement takes place again (Measure) to assess the impact of the actions. Elaborating on the concept a bit further, performance improvement can be considered a major component of closed-loop performance measurement or performance management.

Some of the key themes raised in the literature review were that effective performance measurement should include measures that drive improvement, maximise the effectiveness of the improvement effort and achieve alignment with organisational goals and objectives (Bititci et al., 2000). Furthermore, measurement should be followed by actions, which in turn should lead to improvement (Kochhar et al., 1997; Neely et al., 1997).

2.7.3.1 Organisational Alignment

It has been established that a key characteristic of performance improvement within a defined performance measurement system is organisational alignment i.e. performance measures that really contribute to the realisation of organisational strategy. In many cases (Neely, 1996; Bititci et al., 1997; Bourne, 1998; Bourne, 1999) this is achieved by designing performance measures derived from organisation objectives which are in turn derived from strategy. This is one of the main benefits of a well-defined performance measurement system in that it channels the organisational efforts into a common direction. Every improvement action taken should comply with the predefined business objectives. It should not be in conflict with other actions in other areas of the organisation. Despite the number of publications in the wider area of performance measurement, little work has been undertaken on examining the cause and effect relationships of these actions to organisational goals and objectives. Several authors (Blenkinsop and Burns, 1991; Bititci and Swenson, 1993; Gelders et al., 1993) have carried out research that provides evidence that even in companies where quality oriented performance measures are employed, these are still being used in a manner that does not promote integration. Several cases have been cited where the company's strategy, improvement projects and performance measures were in conflict. Indeed some authors (Fry, 1989; Neely et al., 1997) have reported the use of measures within a PMS in isolation and its adverse side effects. That is, actions that were initiated by performance measures that were properly derived from business objectives were in conflict with other business objectives within the organisation's performance measurement system. In a recent study into 73 commercially available executive information systems (Rigas and Fan, 1998), incorporating performance measurement, very little evidence was found to support the notion that low-level improvement actions are aligned to organisational strategy. This is important since the software industry is usually quick to respond to changes and advances in research in the field of performance measurement (Neely, 1998). In fact, since that report only two software vendors have included a mention of cause and effect relationships in their products. Furthermore, during the initial stage of the benchmarking studies undertaken within the scope of an EU funded project (ESPRIT-TBP Project No.26736), involving several companies from the manufacturing and service sector of both Spain and the UK, no

evidence surfaced supporting that improvement actions were systematically aligned to organisational objectives.

In fact, in the bulk of the literature, the focus on aligning measures to strategy is on deriving them from objectives (Neely et al., 1995; Neely, 1996; Kaplan, 1996a; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c; Bititci et al., 1997; Neely et al., 1997; Bourne, 1999; Bititci et al., 2000; Bourne et al., 2000), and this is possibly one of the reasons that the actions that these measures initiate have not been studied more closely.

2.7.4 Performance Improvement and Continuous Improvement (CI)

The previous section discussed the concept of performance improvement within performance measurement. It is important to stress that the approach to performance improvement should be viewed from a continuous perspective. As was discussed in Section 2.2.4, a large number of authors support the notion that continuous improvement should be integrated within performance measurement. (Lynch and Cross, 1991) explicitly state that:

"The purpose of performance measurement is to motivate behaviour leading to continuous improvement in customer satisfaction, flexibility and productivity".

A significant number of authors have also included the concept of Continuous Improvement as an essential part of good-practice performance measurement system design (Azzone et al., 1991; Neely et al., 1995; Ghalayini and Noble, 1996; Bititci et al., 1997; Neely et al., 1997; Bititci et al., 2000). Continuous Improvement within performance measurement can promote proactive management by focusing on leading measures to facilitate a more proactive management style (Bititci and Carrie, 1998). This concept has a significant impact on the current research, since it promotes a continually improving rather than reactive problem solving approach to performance improvement.

There have been instances where setting targets for performance measures has been criticised for being in conflict with continuous improvement (Fischer, 1992). To this end it is important to carefully set those targets, otherwise they might have a detrimental

effect to employee motivation. Some researchers argue that when targets are met then improvement efforts might slow down. However, not setting targets also contradicts the concept of continuous improvement since companies need to know whether their improvement efforts are bringing results or not (Ghalayini and Noble, 1996). Lynch and Cross (Lynch and Cross, 1991) expand further on the concept by supporting that sometimes continuous improvement is not enough. There is a need to monitor the rate of improvement as well as the improvement of the competition. Benchmarking plays a key role in that concept. The authors also support that a performance measurement system must foster an attitude of Continuous Improvement in all aspects of performance. This can contribute to the feedback of the system being positive when improvement is made, thus positively influencing behaviour (Lynch and Cross, 1991).

2.8 Critique of Current Literature

This section presents a critical analysis of the literature reviewed in relation to the research and the wider field of knowledge that this work is positioned in.

2.8.1 Performance measurement

Literature suggests that well-designed performance measurement systems and well-designed performance measures can contribute to the alignment between an organisation's strategy and performance measures. They can also assist in the effective management of improvement activities towards achieving organisational objectives. Thus, performance measures can be used effectively as a means of managing performance. But the majority of literature concentrates on just stating guidelines on the characteristics of a 'good' performance measure and does not explicitly explain how to specify one in a practical application. In the field of performance measurement design, literature comprehensively covers 'good' design guidelines, but in this case the human element of such an implementation is not fully examined and again there are no specific guidelines given as to the steps needed to ensure a successful implementation.

A good design methodology on its own does not guarantee the success of the resulting performance measurement system. The human reaction to measurement is crucial for organisation success since humans are responsible for the decisions taken to improve

performance. Consequently, any approach proposed should take into account the human or culture element if it is to be successful. The author believes that the devolution of responsibility and initiatives to the operation level where actions are taken is an important part of obtaining improvements from measurement. With appropriate empowerment, operational staff can conduct continuous improvement initiatives like QC Circle and Six-sigma within the overall measurement system of the organisation. To deliver the appropriate empowerment, research needs to discover the potential factors that affect the successful implementation of a performance measurement system and probe why failures occur even when continuous improvement is sought.

2.8.2 The Evolution of Performance Measurement

In well-balanced performance measurement systems the internal state of an organisation should reflect the corresponding competitive priorities. These priorities in turn must reflect the organisation's strategic objectives in respect to its customers. The overall organisation objectives and strategy should be taken into consideration when attempting to improve its performance. Despite the deep research work in the area, there is not enough evidence to support that companies fully understand and can define performance in terms of their competitive priorities. Existing research looks at the trade-offs between those priorities in performance improvement but does not proceed to elaborate on how the trade-offs should be considered. Organisations may take steps to identify these trade-offs and ultimately achieve their effective management by integrating them into their decision making process. However, there is very little theory to guide their practical work. Further research to identify factors and constraints in performance trade-offs is crucial.

2.8.3 Shortcomings of Traditional Financial Measures

The literature highlights comprehensively the limitations of traditional financial measures and their shortcomings in a modern business environment. Business has lived with these limitations since financial measures are still used by the accounting community to represent the bottom line results. These financial indicators are still believed to be an organisation's ultimate measure of success. Since the financial accounting is in monthly and annual periods, they encourage short-termism. These drive the management to concentrate on short-term results rather than long term

strategies. This poses a serious obstacle to the implementation of long-term strategies. Financial measurement systems were developed when direct material and labour costs made up a substantial part of the operations cost. In modern manufacturing and service organisations, the direct costs are only a minor part of the overall cost. As a result, different types of measurement systems are being sought.

2.8.4 Performance Measurement Frameworks

Performance measurement frameworks that incorporate wider perspectives were developed to address the shortcomings of traditional financial based performance measurement. Most of these frameworks offer different perspectives like internal process, human resources, customer satisfaction, impact to society, etc. The majority of the frameworks adopt a top-down approach to examine business performance from a corporate perspective. This reflects the desire of managers to have high level decision tools that help them to control the complex, and number infested operational levels of an organisation, presenting the details in a comprehensive and simple manner. However, it is at those operational levels when actual activities take place within an organisation that real value is added for the customer. Current frameworks fail to link the value-adding activities to the top level financial view systematically. Current performance measurement frameworks virtually ignore the causal links at the operational level. The emphasis on aligning strategy to measures has taken away the focus from aligning the actual improvement actions to strategy. Performance measurement frameworks address the limitations of traditional performance measures and reflect the modern management thinking in the business environment. They are not universal solutions and their suitability heavily depends on the context and area that they are applied in. The time and cost to implement these frameworks is rather substantial. Research in this field should concentrate on potential ways of reducing the cost to benefit ratio when implementing such frameworks.

2.8.5 Cause and Effect Relationships in Performance Measurement

Several performance measurement frameworks included some form of causal relationships in their structure. This is the current trend set by several authors who identify and acknowledge the benefits of having causal links. As yet, there is no established integration of causality in the process of performance improvement and any

instances found are of limited depth and value. This is due to the fact that the complexity presented by the task of integrating these relationships formally in a performance measurement system requires input from both management and the operation staff, and the process is slow and costly. Researchers who can only capture a snapshot of the situation find it difficult to generalise theories in the high-speed ever-changing business environment where time is limited. This restricts the access researchers have to in-depth company data, reflected in the immaturity of causality within PMS research.

2.8.6 Performance Improvement

Ideally, continuous performance improvement in an organisation is achieved through a combination of internal and external drivers. Current performance improvement approaches are limited in that they are usually uni-dimensional in their implementation, i.e. concentrating on only operational (bottom-up) or corporate (top-down) improvement. Although several approaches suggest effective triggers for improvement, they do not go far enough to ensure that they address an organisation holistically. Quality based approaches tend to concentrate on localised improvement and their success is measured by using solely quality-based measures. Managing approaches using assets, processes and/or technologies to achieve organisational improvement mainly concentrate on a single criterion i.e. growth, new products, market share; and again fail to take into account the impact of improvement on the organisation as a whole.

The reason could be traced to the reactive nature of most organisational cultures rather than proactive, i.e. focusing the improvement effort to a single area in the organisation only when there is a need. Moreover, organisation politics put up barriers that are very difficult to overcome if one is to assess the impact of improvement through a holistic viewpoint. Integrating the concept of continuous improvement with performance measurement requires commitment and organisational resources so that people are clear about the goals and objectives of the implementation. Significant business benefits could be gained by research into the successful integration of the concept of continuous improvement in organisations that do use performance measurement as a management

tool, but not making full use of its potential as a strategy alignment and realisation instrument.

2.9 Relating Literature to the Thesis Research

The review of literature in this chapter lead to a number of issues that relate to the research reported in this thesis. The extended research into what constitutes a 'best' designed performance measurement system and performance measure was undertaken to establish the structure on which an improvement framework should be developed to achieve strategic alignment of improvement actions by utilising the hierarchical links in the performance measurement system. The review established that balanced performance measurement can lead to the effective strategic alignment of the organisation (See section 2.2.4). This can be achieved by designing measures using 'best' practice guidelines that are reported by many authors (See section 2.2.3). The implication to the current work is that a well designed performance measurement system can provide the basis on which the proposed improvement framework can deliver strategically aligned performance improvement. Within the context of using performance measurement, the literature indicates that there are great benefits in implementing such an approach. However, the usability of such a tool when initiating performance improvement actions is limited by the lack of explicit causal links relating actions to measurement (See section 2.6). Various approaches and techniques reported in literature do not integrate formally these causal links in the process of decision-making. The approaches cited in the literature do little to explicitly link high-level objectives to low-level actions. Especially in the context of performance measurement, several authors support the need for an integrated approach (See section 2.6). The review suggests that to achieve the effective integration of causality within the performance improvement process several elements should be included to facilitate it:

- well-designed performance measures to ensure the link between strategy and measures;
- factors that affect performance to understand the causal links between improvement actions and performance measures;
- improvement actions that comply with the organisational circumstances and strategy; and finally

- a 'well' designed PMS structure to facilitate and enable the devolution of such causal links.

The analysis brings the above points together in the following identified gaps:

- There is little work undertaken linking performance improvement actions and business strategy.
- There is a need to understand the relationships between low level performance measures and strategic objectives and these relationships should form an integral part of the improvement actions. However, no generic business model or framework exists that provides structured links between measures at different organisational levels.
- There is a need not only to understand the impact of low-level actions to higher-level objectives but also to do so in a manner that takes into consideration the current circumstances of the business including resources etc.
- The majority of work on achieving strategic alignment in performance measurement has concentrated on the definition of measures from business objectives. However, very little work has been undertaken below that level and regarding the interrelationships with business objectives. It has become clear in literature that this can lead to sub-optimisation or actions that might be in conflict with overall business objectives. In that sense, strategic alignment in performance measurement has not been examined from a low-level action perspective.

Chapter 3 - Research Methodology

3.1 Overview

The research effort is broken down into discreet steps that incrementally build up the performance improvement framework. The overall research methodology is based on the theory building approach, drawing in established performance management literature and empirical case studies as appropriate. As there is no known research model that covers the whole scope of the intended performance improvement framework, literature is used to create an initial conceptual framework. The empirical part of the research is then used to establish the industrial relevance and practical implications of the wider research field.

The author conducted the research during his employment as a researcher participating in a large scale European Commission funded research project in business performance measurement. This enabled the in-depth access to the partner companies that have a mature performance management practice. Their experienced staff contributed to the empirical part of the research.

Section 3.2 presents the European Commission funded 'TQM-Tile' project and its relationship to the research in this thesis. Section 3.3 presents the overall research methodology design and Section 3.4 discusses the conceptual performance improvement framework underpinning the research. The selected research design is presented in Section 3.5 and Sections 3.6 and 3.7 discuss the data collection and analysis methodology employed respectively. Section 3.8 discusses the link between theory and practise by outlining how the empirical part of the research complemented the theory development. Section 3.9 presents the validation of the concept within the research methodology and Section 3.10 outlines the tactics employed to ensure the validity of the research in various stages. The Chapter concludes with the outline of the publications produced at various stages of the research.

3.2 The TQM-Tile Project

TQM-Tile (Project No.26736) was a project undertaken within the ESPRIT initiative of the European Union and formed part of the Technology for Business Processes section of the EU's Research and Technology Development Fifth Framework. The project involved participants from three different countries encompassing a wide range of industrial experience, skills and academic excellence. The project lasted a total of 32 months from June 1998 to January 2001. The individual participants were (in alphabetical order):

Business Integration Technologies Limited (UK) – is a software developer of Business Modelling products and provider of associated support services. The company is also the manufacturer of [1]Enterprise Modeller®, a leading Business Modelling tool.

Cranfield University (UK) - Cranfield University is one of Western Europe's largest academic centre for strategic and applied research, development and design. The Department of Enterprise Integration and the Cranfield Manufacturing Business Consultancy contribute their industrial research and consultancy experience in enterprise business process and organisation improvements.

ESADE (Spain) – is a prestigious Business School tightly linked to the Spanish business environment. ESADE has a Management Development Centre (which is located in Madrid and Barcelona, the most important economic centres in Spain) in addition to the University's Degree, Masters, and Doctorate degree courses.

Gres de Nules (Spain) - is a ceramic tile manufacturer with an excellent reputation for product quality and exports to more than 100 countries around the world. Gres de Nules as an end-user of the TQM-Tile project results is providing the validation.

[1] Enterprise Modeller is the registered trademark of Business Integration Technologies Limited, in the United Kingdom, the United States and within the European Community.

Universitat Jaume I (Spain) - focuses its activity on the creation and transference of knowledge as well as on promoting the cultural and economic development of its social environment. UJI has strong links with the ceramic tile manufacturing sector with which it has completed a number of successful research initiatives.

Wendel (Germany) - is an enamel and ceramic glass production company with more than 70 years of experience, present in all the international markets exporting high quality products.

3.2.1 Project Description

The TQM-Tile project was initiated to develop a methodology and supporting tools to help businesses to focus on customer value. This is achieved by the integration of their business process and performance measurement system. The methodology guides an organisation to develop its business processes in line with its mission and vision by decomposing and classifying its business processes to provide a clear picture of its operations. The business process focus is part of the Business Excellence model in ISO 9000:2000. The software tool developed supports the implementation of an integrated model to provide instantaneous information on the state of the different business processes. Process based performance measures with 'real time' information allows business to pre-empt problems. Improvement initiatives and actions could be fully justified, leading to continuous improvement. The project brings together best practices in process and performance management and a practical, validated methodology to achieve performance management through process management.

The project was organised in a number of work packages and related deliverables. The work package plan is depicted in Figure 15.

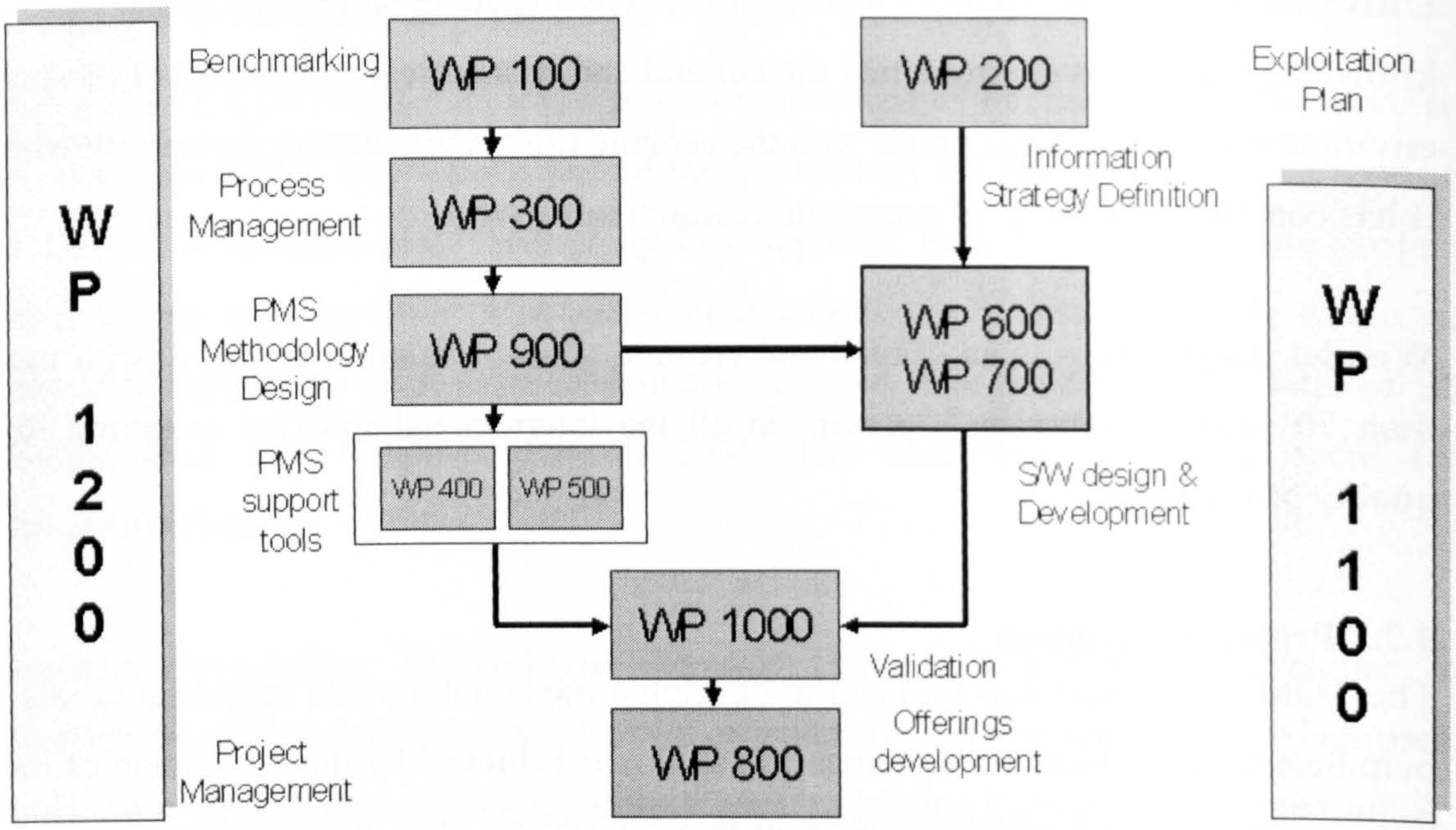


Figure 15 List of work packages

Overall there were 11 researchers involved in the project throughout its duration in addition to the 6 project managers. Table 1 shows the role and involvement of the researcher through the author's involvement in the deliverables of the TQM-Tile project.

DELIVERABLES		Involvement	Role
DL1	Best Practice Report	PMS Market analysis	Contributor
DL2	State-of-the-art reports	EIS report	Owner
DL4	Performance Indicators Library	Indicator Definition	Contributor
DL8	Process Costing Analysis	Review of software applications	Contributor
DL9	Methodology for the PMS Design and Implementation	PMS Design PMS Review PMS Implement PMS Action	Contributor Owner Contributor Contributor
DL10	Indicators relationship assessment	Indicator study, literature review and model development	Owner
DL12	PMA S/W APPLICATION*	Beta testing	Contributor
DL13	TRAINING COURSES HANDBOOK*	Performance Measure design guidelines	Contributor
DL14	CONSULTANCY HANDBOOK*	PMS Review guidelines	Contributor

DL17 Exploitation Plan	UK Marketing Plan UK Business Plan Market Analysis	Contributor Contributor Contributor

Table 1 EU project involvement

* Items in capitals denote final project results

The achievements of the deliverables relevant to this thesis are discussed in detail in Chapter 4 and 5, which also presents the details of the individual elements the author developed within the project framework.

3.3 Design of the Doctoral Research Methodology

(Zikmund, 1997), argues that the choice of research methodology should support the nature of the research problem. Within the context of this research, and considering the gaps identified in Chapter 2 and the overall nature of the research problem, a theory building approach is chosen. This reflects the considerable amount of work needed to develop the concept of the performance improvement framework as opposed to just testing a hypothesis, without really considering its origins (Eisenhardt, 1989). (Flynn et al., 1990) propose that the research process should start with either assumptions, frameworks, perceived problems or perhaps a very tentative hypothesis. The key feature of theory building is that it enables the gathering of information in order to refine the tentative theory or hypothesis through analysis. Supporters of the theory-building methodology argue that a stronger theory will result if it has been based on real data (Glasser and Strauss, 1967; Yin, 1994). Consequently, the theory becomes an evolving entity as data is collected.

The concepts investigated throughout this research mainly involve qualitative knowledge being derived from theory and real experience. To ensure the theory building nature of the research ties in effectively with the necessary industrial input, a structured approach was used. Flynn's systematic approach for empirical research in operations management (Flynn et al., 1990), provided the structure on which the research methodology was based. One of the main considerations in selecting Flynn's process is the fact that throughout its steps it carefully considers the reliability and

validity of the process elements, which are important to the research. Flynn et al, developed a six-step process for undertaking empirical research. The steps cited in their approach are:

1. Establish the theoretical foundation
2. Select a research design
3. Select a data collection method
4. Implementation
5. Data analysis
6. Publication

The sequence of the steps as well as certain possible elements within each stage are shown in Figure 16.

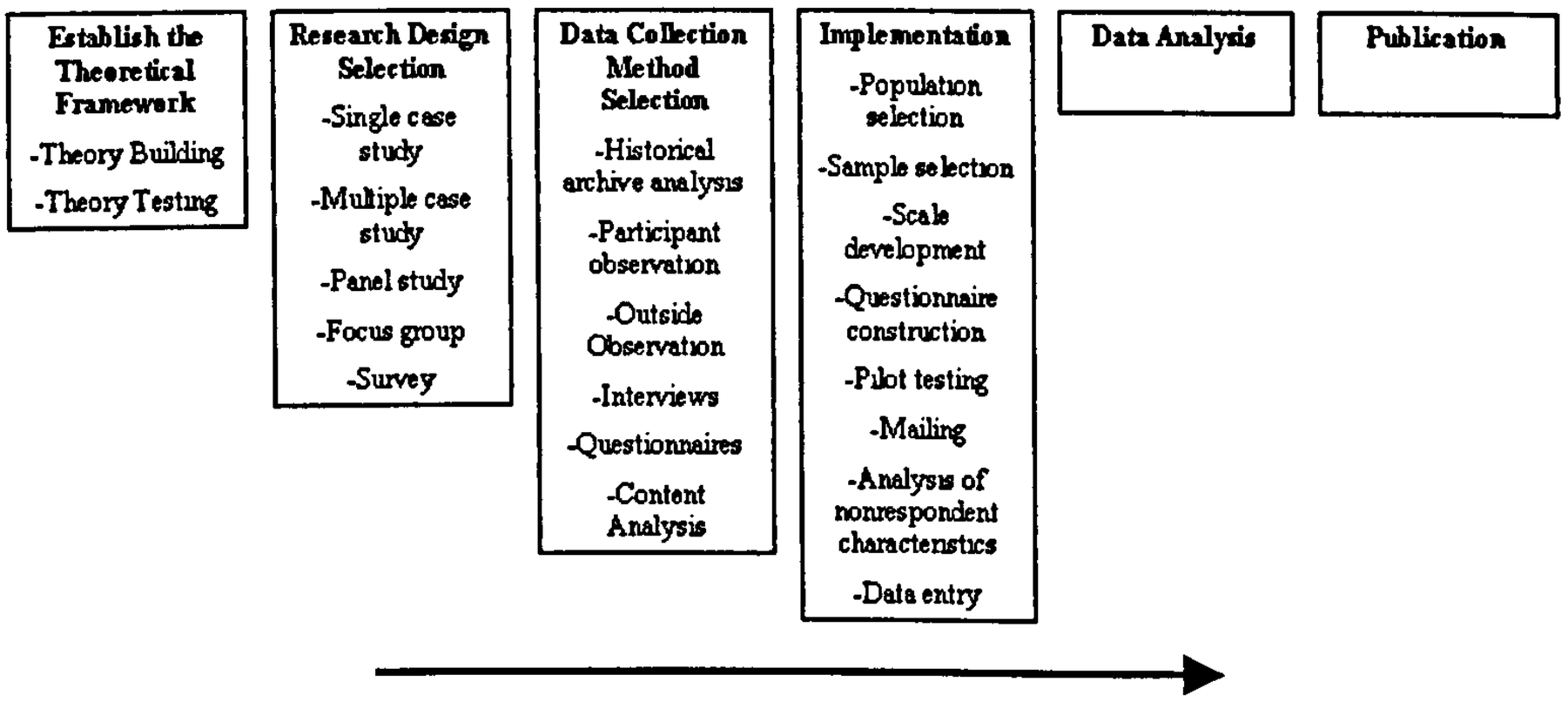


Figure 16 A structured approach for empirical research (Flynn et al, 1990)

The structured approach ensured that theory was developed rigorously throughout the research. The initial theory and the conceptual framework underpinning the research were developed from the literature review in Chapter 2. The detailed description of the work done in the development of the performance improvement framework will be presented in Chapters 4 and 5.

Despite theory building and theory testing being referred to as two distinct approaches, this is rarely the case (Eisenhardt, 1989; Gill and Johnson, 1997). Indeed, both approaches complement each other and are inseparable in that they might overlap each

other at a specific stage during the research (Emory and Cooper, 1991). It is argued by several authors that theories are never proven or disproven, but rather are constantly evolving (Glasser and Strauss, 1967; Strauss, 1987). The value of theory building lies in its permitting a wider range of observation and inquiry than the more traditional theory testing does (Flynn et al., 1990).

The following section in the thesis focuses on the development of the theoretical foundation of the research. This includes the development of the conceptual framework upon which the research is based. The framework is formulated and populated with the initial data collected from the literature. Moreover, the case studies undertaken provided the empirical data necessary to fully investigate the initial theory developed, and ultimately modify it. The resulting theory and the revised model were then tested and further developed through its application on a working performance measurement system. This ensured the validity of the revised theory as well as its applicability and usability within the boundaries of a business performance measurement system.

3.4 Conceptual Performance Improvement Framework

Theory provides the foundation for all scientific research (Flynn et al., 1990). This is very important, especially in disciplines such as operations management, where theories could be too implicit or difficult for the researcher to articulate (Buffa, 1980; Flynn et al., 1990). A conceptual framework based upon already established literature was developed to underpin the research, which essentially set the foundation for the research process. The conceptual framework concentrates on the key issues (Miles and Huberman, 1984) and is illustrated in Figure 17.

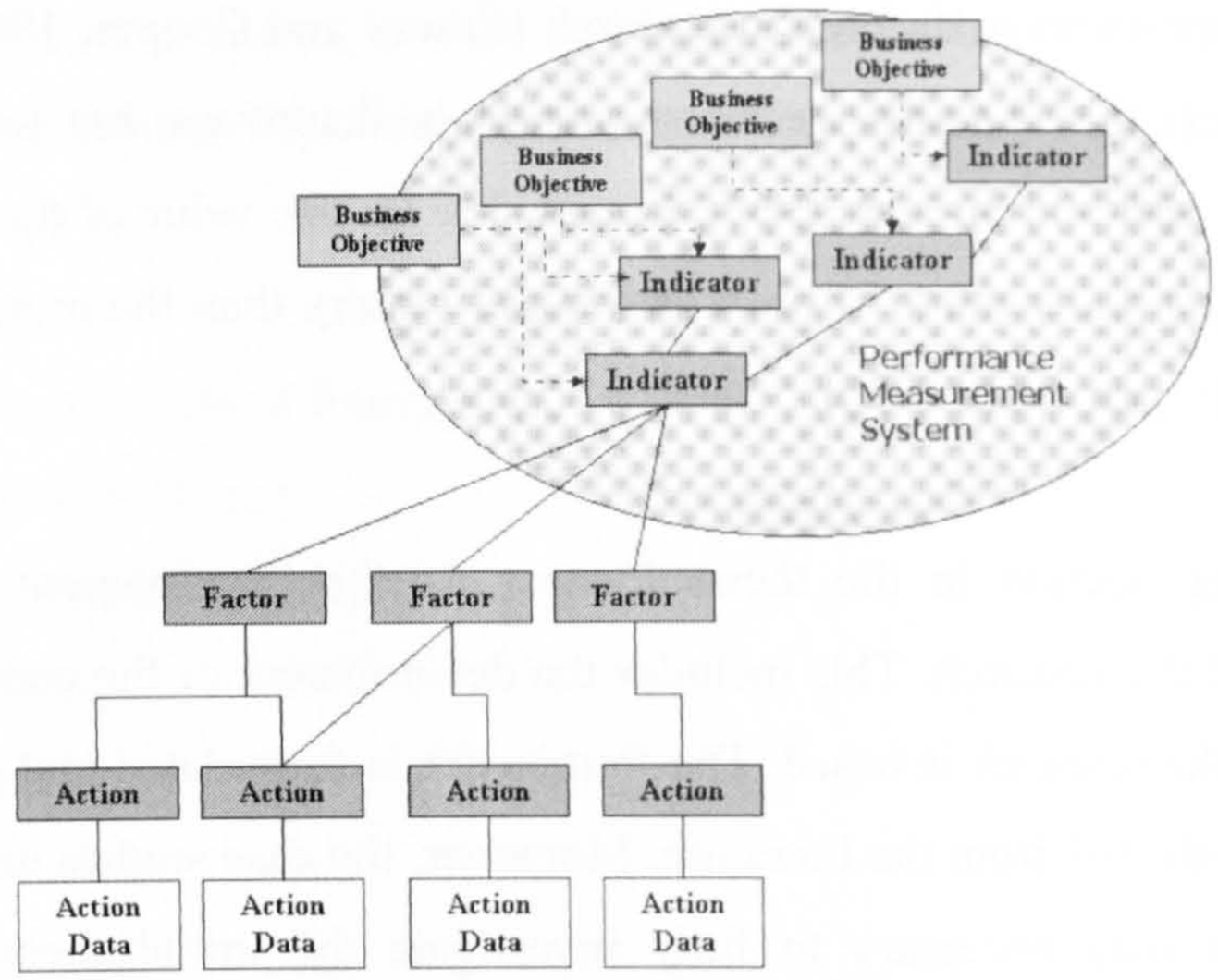


Figure 17 The conceptual framework

The framework illustrates the researcher's perspective of the relationships between business objectives, performance indicators, factors that can affect the performance of a specific indicator and actions that can be initiated by these factors to improve the indicator's performance. By enriching and testing this framework, the relationships between its elements could be established. Consequently, this will lead to the investigating of the initial hypothesis.

3.4.1 The Structure of the Performance Improvement Framework

The illustrated conceptual framework aims to link the low level activities in a business to higher level business objectives. The conceptual model of performance improvement decision making is a four-stage process. The simplified view is to identify the relevant business objectives, monitor the related set of indicators, consider the relevant factors that influence the indicators and select the actions that each of the factors may lead to. The actual decision making is much more complex and not necessary sequential. The research aims to create the intellectual framework that captures and represents the information for well informed improvement action decisions making the best use of sound performance measurement. It tries to do so in a way that retains the strategic alignment at all stages of the process. The framework represents the cause and effect

relationships that exist in a business and seeks to systematically organise them and integrate them in the performance improvement process.

3.4.2 Business Objectives and Indicators

The top level business objectives have been defined in terms of the strategies disused in Chapter 2: Quality, Cost, Delivery and Flexibility. They are the starting point for the definition of the framework. The framework links those strategies to strategic objectives and to the next level, which are the performance measures that could be derived from these objectives. This part of the framework is consistent with the literature findings discussed in Chapter 2, suggesting that performance measures should be derived from business objectives, to contribute to realising the strategy of the business.

3.4.3 Factors of Performance

The next set of relationships in the framework involves identifying the different factors that might affect the level of performance of the performance measure. Consequently, these factors can initiate specific actions. This is based on the assumption stated in Chapter 1 that to achieve a change in a performance measure one must alter one or more of the factors that affect it. The framework captures the impact of these actions on the specific performance indicator and through the cause and effect relationships within it, traces it to other areas of performance. In other words, the framework identifies other measures of performance that might be affected by this action and as a result can indicate the impact of one action on the whole performance measurement system. The notion is to capture not only the hierarchical breakdown of causal relationship but also to recognise that a factor can influence multiple business objectives. A key characteristic of the framework at this set of relationship is the consideration of potential trade-offs in the business decision making process. For instance, if an action can affect positively a specific performance measure in one area of the business, but have a negative effect on another performance measure, then this is a consideration that should be included in the equation when deciding on possible actions for performance improvement. The framework seeks to highlight possible conflicts and trade-offs, however it does not seek to provide specific solution paths, since as it was established in

Section 2.5.4, a business is a dynamic system and consequently its circumstances change.

3.4.4 Actions and Operations Constraints

The final set of relationships in the framework lies within the identification of the possible actions that could be taken to manipulate the factors and the related operating constraints. Example operating constraints are limiting factors such as resource availability (human & physical), time and cost restrictions and also information and/or material needs. In addition to the operations constraints, the framework captures the information on the level of authority needed to approve the actions and whether the organisation has any control over them. The framework captures the details of these constraints for each action, hence allowing a more informed decision to be taken. Consequently, the framework achieves the conceptual alignment of the whole of the organisation, from the low-level actions to the strategic business objectives, through the use of the performance measurement system to drive performance improvement.

3.4.5 Illustration Example

To illustrate the concept underpinning the conceptual framework, one of the measures encountered in one of the participating companies is shown as an example. Figure 18 illustrates the use of the framework in that scenario:

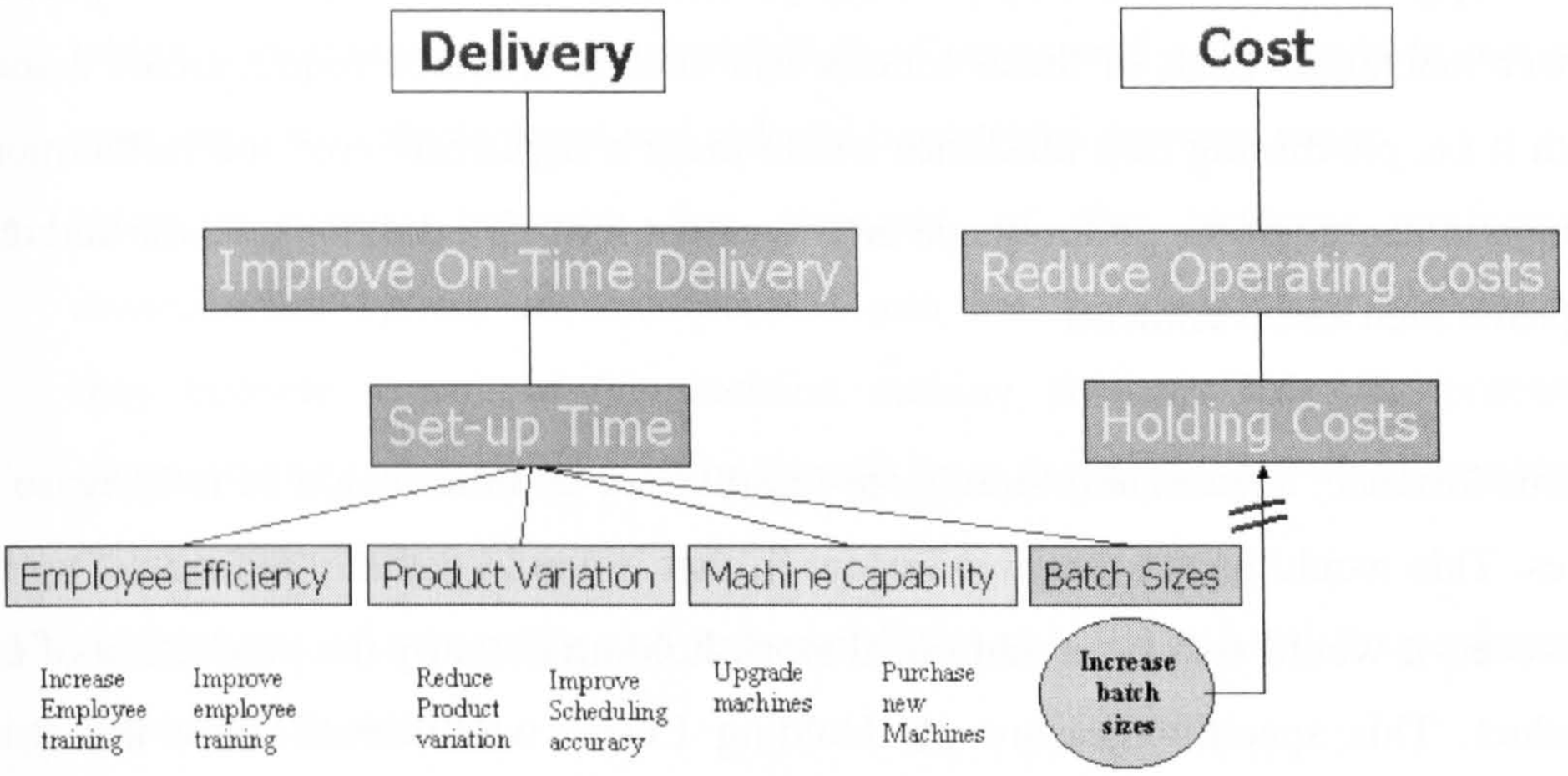


Figure 18 Example of the framework in use

As the illustration suggests, the company was trying to improve their on-time delivery. In this context, the overall lead-time was measured and one component of lead time is set-up time. The framework explicitly links strategic objectives, i.e. in this case to improve on–time delivery, to the measures used in the performance measurement system. In this example, to improve on-time delivery the company has to reduce overall lead time and consequently set-up time.

At the next level, some of the factors that were identified as affecting set-up time were:

- Employee efficiency, i.e. the ability of employees to change machine set-ups as quickly and as effectively as possible.
- Product Variation, i.e. number of different products in the production line.
- Machine capability, in this context, capability refers to how easy the machine is to change set-up; and
- Batch sizes, the size of each product batch in production.

Furthermore, the actions that can be initiated by each of these factors were identified. For instance, in the case of Machine capability, the two possible actions would be to

either upgrade the machines by possibly purchasing add-on components, or purchasing newer machines. Each of these actions had several resource requirements associated with it i.e. purchasing new machines would incur a significant cost and furthermore the person in charge of the performance improvement initiative did not have the authority to approve such an investment.

In this instance, a reasonable strategy to improve set-up times could be to increase batch sizes. This would have a positive impact in that it would actually reduce set-up times, however, it would also incur additional stock holding costs by the production of excess product. This specific measure of 'Holding Costs' was derived from the strategic objective of cost reduction and consequently taking the action of increasing batch sizes to reduce set-up times would have a negative impact on the objective of reducing operating costs. Thus, the framework highlights the effect of an action on a measure or business objective, and moreover if it is in conflict with a measure or objective in another area of the business.

The example shown is a simple one and does not truly represent the complex nature of a business performance measurement system.

3.4.6 Justification of the Conceptual Framework

The structure of the framework is designed to allow the integration of business objectives, performance indicators and factors into the decision making process. The successful implementation of the framework will make explicit the business objectives throughout the organisation. This will ensure that employees will have a better understanding of the impact of improvement actions on the strategy of the business. There are a number of potential benefits from the implementation of the framework:

- Maximum alignment of business objectives, measures, and actions to business strategy, thus improving the organisation's ability to improve effectively.
- Decision-making and performance improvement initiatives are also undertaken at a lower level, hence the process becomes quicker, and as a result improves organisational flexibility and responsiveness.

- Reduced sub-optimisation through the use of operational constraints when taking performance improvement actions. Consequently, this leads to increased organisational effectiveness and reduced operational resource usage.
- Interrelationships between the elements of the business performance measurement system are incorporated into the framework and consequently, they become a part of the decision making process. This can potentially contribute to a potential change in attitude from the employees when considering improvement actions.
- Assignment of ownership and responsibilities at a lower level for performance improvement actions.

The framework was developed with several considerations reflecting the literature review findings in Chapter 2. The framework will be able to accommodate the cause and effect relationships present in a performance measurement system. These relationships as well as their strengths might be unique from organisation to organisation, but nevertheless the framework allows for their deployment through the hierarchy of the performance measurement system. The literature review revealed several of the key characteristics that the framework should incorporate to enable performance improvement. These characteristics were consistent with the literature findings and formed the basis for the initial development of the framework. Some characteristics related to the design of the performance measurement system the framework was implemented upon, and other related to the structure of the framework itself. These included:

- Hierarchical structure enabling the cascading of business objectives and measures.
- Inclusion of cause and effect relationships and a mechanism to assess their strength.
- Effective management of the number of measures used – The framework encourages the constructive elimination of unnecessary measures, since a large number would result in an even larger number of cause and effect relationships that would render the framework unmanageable.

- The framework should reflect the data collection methods already employed in the company's performance measurement system and take advantage of explicit links between measures and objectives already deployed.

3.5 Research Design

The second step in Flynn's approach (Figure 15) is to select the research design. Section 1.6 decomposes the research into five detailed objectives that form the sequence of the knowledge build-up to develop the performance improvement framework. The practicality of research means that the knowledge was gathered in a number of research actions, some of them overlapping and iterative. This section of the thesis explains the selection of the specified research actions and outlines the contribution of the work relating to the research objectives.

3.5.1 The Selection of Research Actions

Generally speaking, business research can be classified as function or technique based. Experiments, surveys and observation studies are commonly cited research techniques. The nature of the problem determines whether the research is exploratory, descriptive or causal (Zikmund, 1997). The same author provides a definition of the three types of research:

Exploratory research - The initial examination conducted to identify the nature of a research problem. Its main objective is the better understanding of the dimensions of a problem through exploration.

Descriptive research – The purpose of descriptive research is to assess and describe the characteristics of a phenomenon. As opposed to exploratory research, descriptive research is usually based on some previous understanding of the problem being investigated (Robson, 1997).

Causal research – This type of research mainly deals with the understanding of causality, by examining an established situation and attempting to explain it.

Table 2 summarises the nature of the approach followed and the research actions for each of the research objectives set out in Chapter 1:

Research Objective	Type of research	Research Actions
1. Establish the characteristics of a 'well' designed performance indicator and performance measurement system	Exploratory	- Literature Review - Practitioner and academic contact - PMS design guidelines and classification - *DL9 PMS design methodology development*
2. Achieve a better understanding of the relationships between performance indicators and the factors that affect them at different levels of a business	Descriptive	- Literature Review - *EIS study* - Visual basic tool model - Practitioner and academic contact - *DL10 Indicator interrelationship analysis*
3. Understand the impact of improvement actions on the overall business performance and the requirements for initiating such actions	Descriptive	- Literature review - *DL10 Indicator interrelationship analysis* - Case studies
4. Develop a framework for initiating performance improvement in accordance with the business strategy and operational circumstances.	Descriptive Causal	- Literature Review - *EIS study* - *DL9 PMS design methodology development* - VB tool model - *DL10 Indicator interrelationship analysis* - Case studies
5. Establish the business, operational, functional, and structural requirements of the performance improvement framework	Descriptive Causal	- *EIS study*

Table 2 Framework development research overview

The research actions that make up part of the TQM-Tile project deliverables as detailed in Table 1 are shown in italics.

The first research activity aimed to establish the characteristics of 'well' designed PMS and measures as the baseline for the improvement framework development. As

improvement is a relatively new area in performance measurement research and the viewpoints of different researchers are diverse, exploratory research was undertaken to establish the current state of research and to integrate the variety of sources into a common format. This then forms the reference for the definition of performance measurement systems in this thesis.

The second research activity sought to achieve a better understanding of the relationships found in PM systems by collecting examples in literature and business case studies.

The research continued by adopting a descriptive approach to understand the potential impact of improvement actions in a PMS by describing the requirements needed to undertake such actions in a business environment.

The development and validation of the performance improvement framework (activities 4 and 5) necessitated the adoption of a combination of causal and descriptive research. The main purpose was to work out the how and why of improvement actions, the factors and the constraints and also the understanding of the causal links underpinning them to achieve the required organisation objectives. The descriptive part of the research collated the examples in literature and published case studies.

The research actions to develop and validate the framework are separated into two broad groups. Those based on literature and those based on interaction and data gathering from industrial practitioners. Actions in the first group are the primary means of framework building to create the conceptual model of the performance improvement theory. These are reported in detail in Chapter 4. Interaction with the practitioners has influenced the applied nature throughout this research. The research actions that systematically capture the industrial input to refine and establish the causality of relationships in the framework are through case studies. The next section explains the choice of multiple case studies. The detailed execution of the case studies is reported in Chapters 5.

3.5.2 Multiple Case Studies

Since the current research is concerned with examining the interaction of performance improvement and performance measurement, multiple case studies allowed for the collection of data to enable the observations to be put within the research context. Additionally, this also contributed to identifying factors directly contributing to the research. The unit of analysis selected for the case studies was the individual managers – since they are the main decision-making element in a performance measurement system – in the case study companies.

Multiple case studies allow for the collection of more compelling evidence (Yin, 1994), and as a result the overall approach is considered to be more robust. Multiple case studies are considerably more time and resource consuming than for instance, single case studies, but the involvement of the author in the TQM-Tile project allowed the case studies to be undertaken within its context.

Multiple case studies allow for detailed areas to be studied in some depth whilst allowing comparisons between cases that can be translated into results that can either be generalised or are case specific (Yin et al., 1983). However, it is strongly argued that one should also consider viewing multiple case studies from a 'replicating' perspective as well (Yin, 1994). Moreover, multiple case studies allow for conceptual rather than statistical generalisations to be applied form organisation to organisation (Yin, 1994). To this end, it is possible to identify the underlying reasoning behind the observations made during these case studies.

Multiple case studies have been widely used to generate theory (Harris and Sutton, 1986; Gersick, 1988) and the validity of the approach has been well documented (Eisenhardt, 1989; Yin, 1994). In the context of this research multiple case studies were undertaken with two of the companies participating in the TQM-Tile project. The case studies contributed to the development of the research concept. The detailed undertaking of the studies is discussed in Chapter 5.

3.5.3 Summary

This section outlined the research methods selected to undertake the research in accordance with the research objectives set out in Chapter 1. A combination of literature analysis and multiple case studies was presented as the chosen method. The details of the individual research actions carried out within each of the methods will be discussed in Chapters 4 and 5. The next section will outline the data collection method selected during the undertaking of the case studies.

3.6 Data Collection Method Selection

(Yin, 1994), suggests that there are six main sources of data evidence in case study research:

- Documentation
- Archival records
- Interviews
- Direct observation
- Participant observation
- Physical artefacts

For the purpose of this research interviews were used as the main research instrument. (Yin, 1994), suggests that the degree of detail available through interviews is unattainable with other methods such as a questionnaire. According to (Yin, 1994), interviews are very well suited to answering the 'Why' and 'How' questions within a research framework.

Interviews allow the researcher to extract information on a more detailed basis since the face-to-face contact with the interviewee allows for clarification of potential points of debate. Furthermore, since the interview is usually undertaken at the premises of the company in question, it might be possible to have access to extra information that can be found on site as well as having a first hand experience of company operations. Moreover, interviews can uncover new and unexplored topic areas. (Poolton, 1994), also supports that with interviews, meanings can 'emerge' as opposed to being forced

into categories. On the other hand, he also notes that interviews can be affected by the degree of the structure of the interview, and that since it is a lengthy process it can be prone to distortion. A further consideration in using interviews is that since the interviewer skills are central to the process, there is always a possibility of bias.

According to (Yin, 1994), the most commonly used case study interviews are open-ended and focused. In open-ended interviews the investigator can ask key respondents for the fact of the matter as well as their opinion about certain events. In this type of interview, respondents can provide a useful amount of information that can sometimes also contribute to the data collection method itself. In focused interviews the investigator is likely to follow a certain set of questions derived from the case study protocol. In the context of the current research, the type of interview used was a combination of the two approaches. The reasoning behind this selection was that the purpose of conducting the interviews was twofold. Firstly, they were used as a means of theory building and to establish whether current business practices reflected the gap identified in literature, and thus needed to be open-ended to allow for enhanced receptiveness of information. Secondly they were used for the detailed development of the framework and thus needed to be focused to allow for more accurate data collection. (Yin, 1994), argues that interviews are an essential source of case study evidence and that they can provide useful insights into a situation.

Nevertheless, during the course of the research the author had the opportunity to complement the research interviews with direct observation at the companies visited and also by examining historical data (reports, archived documents) that became available and was regarded useful to the research.

3.7 Implementation & Data Analysis

In the implementation of the case studies, in each case study company, the interviews were performed in two stages:

1. Preliminary interview with senior management to obtain background information about the company, its strategic orientation and its business environment

2. Main interviews that were undertaken with process/measure owners and were designed to extract greater detail regarding the company's attitude and understanding of performance measurement, the use of performance improvement and causality within their performance measurement system.

A total of 31 managers participated in the data collection, of which 8 were senior managers.

Interviews – These interviews were aimed at collecting information regarding the structure and the operation of the performance improvement framework. Information was collected regarding the company's attitude towards performance measurement and performance improvement as well as information regarding performance measures, factors and actions. This part of the research contributed greatly to the modifications to the conceptual framework.

The case studies contributed to testing and developing the applicability of the performance improvement framework. This ensured that the research concept clearly reflected the existence of an appropriate industrial problem, and that the gap it sought to address was not a mere academic pursuit.

The case studies provided valuable information regarding the building of theory throughout the research. Moreover, at all stages of the data collection there was always an element of frequent overlap of data analysis and collection. Many authors support this notion (Glasser and Strauss, 1967; Eisenhardt, 1989), and indeed it is considered to be one of the key characteristics of theory building from case studies. Overlapping data analysis with data collection can give the investigator a head start in the data analysis, and also allows for greater data collection flexibility. In fact, this flexibility is one of the main features of theory building as it has been successfully demonstrated by several authors (Burgelman, 1983; Harris and Sutton, 1986; Sutton and Callahan, 1987; Gersick, 1988).

During the case studies a lot of information regarding the deployment of cause and effect relationships throughout a performance measurement system and their uses in performance improvement was collected and fed back to the conceptual framework for further development. Moreover, this helped in forming the data collection requirements for the validation stage of the research and contributed to identifying weaknesses or gaps in the framework. To summarise, the data collected from the case studies provided input to the refinement of the framework by:

- Providing a deeper insight into the data collection method implications.
- Providing additional information regarding the relationships between actions, factors and indicators in a real business environment, that were not considered previously.
- Contributed to the theory by setting the foundation for identifying specific factors that influence company measures and the specific actions that may or may not be initiated by these factors.

3.8 Developing the Final Framework

This stage of the research concentrated on processing the information that was collected from the case studies and modifying the initial conceptual framework. The modifications that were made to the framework were classified as being:

- Structural modifications – Modifications carried out to the structure of the framework i.e. the method used for the deployment of cause and effect relationships, the hierarchical structure of the framework's elements etc.
- Implementation/deployment modifications – These include all the modifications affecting the implementation of the framework in a real business environment and included data collection methods used to populate the framework, and other operational issues.

During this stage a lot of attention was paid on adapting the framework to the actual business environment that it would be implemented in. In other words, issues and

processes that could potentially facilitate its implementation were taken into account to a certain extent, but not so as to make it implementation specific.

This part of the research resulted in the final version of the framework, which included:

- The final structure.
- The data collection methods and procedures.
- The performance improvement initiative procedures.
- The decision-making component of the performance improvement initiative.

The next section outlines the validation of the applicability and usability of the final framework, which included its population with data actually collected by the participating company's performance measurement system.

3.9 Validation

The validation of the framework was a two-stage process and had the objective of validating the framework's applicability and usability as defined by the research objectives. The validation process was applied on one of the major processes of one of the participating companies and was split into two stages. The stages were as follows:

1. Data collection stage – The framework was populated with data from the company's performance measurement system. This included performance measures, business objectives and information regarding the cause and effect relationships present in the system. Moreover, information was collected regarding the resources needed to initiate each improvement action as well as the potential impact of each action. For this stage of the data collection, structured interviews were used as the main instrument to collect the information. Structured interviews were considered appropriate at this stage to ensure the accuracy of the data collected and also to be able to clarify any points not well understood with the people involved. The interviews were carried out with people from management and process/indicator owners of a specific business area.

2. Performance improvement stage – This stage of the research involved the company being asked to use the performance improvement framework as part of their performance measurement system and comment on its usability and applicability. The results were fed back to the author for confirmation.

3.10 Research Validity

Unlike theory testing approaches, such as surveys that rely upon statistical analysis to obtain results and establish their validity, theory-building techniques are better addressed using a different approach. (Yin, 1994) suggests that a set of logical tests is applied to assess the quality of the research design. He also identifies several tactics for dealing with these tests. Table 3 summarises the tests and the tactics used within the context of the research.

Tests	Objective	Case Study Tactic	Research Stage
Construct validity	Was there full access to the available knowledge and participant interpretation?	- Multiple sources of evidence - Chain of evidence	Data collection
Internal validity	- Are there causal links in the series of events?	- Explanation building	Data analysis
External validity	- Can the research be reasonably generalised?	- Replication logic used	Research design
Reliability	Can the same study be repeated with the same results?	- Case study protocol	Data collection

Table 3 Research validity tactics

The design and execution of the thesis research satisfactorily addresses these issues of research validity.

3.11 Publication

The research yielded a number of publications that have been published in various stages throughout the course of the research. These include work on the earlier stages of the framework development (Rigas and Fan, 1998; Fan and Rigas, 1999), and its development towards the end of the research (Rigas and Fan, 2000; Rigas and Fan,

2001). Additionally, there were publications in the scope of the European research project regarding the research's link to the field of performance measurement and improvement (Rigas et al., 1999; Rigas et al., 2000). There have also been publications regarding the research and its contribution to the EU-project (Najmi et al., 1999), as well as work regarding cause and effect relationships in the area of performance measurement (Rigas et al., 2000).

3.12 Summary

This chapter explained the conceptual framework underpinning the research and justified the research steps and instruments that were undertaken. The methodology used to investigate the hypothesis was also identified and the different stages of the research were briefly introduced. These will be discussed in the following chapters.

Chapter 4 – The Conceptual Performance Improvement Framework

4.1 Overview

Chapter 2 established the need to improve the strategic alignment of low-level improvement actions to the strategy of the business. It identified the need for the proposed performance improvement framework that can link the improvement actions to the performance measures and factors that affect them on a continuous improvement basis. Chapter 3 established the conceptual framework underpinning the research, and presented the research methodology. This chapter discusses in detail the steps taken throughout the development of the performance improvement model from its early conceptual stages (formulation). The execution of the research methodology steps laid out in the previous chapter is presented. The development of the framework consisted of two stages:

- Identification and justification of the elements that should be included in the framework to enable strategically aligned performance improvement actions.
- Identification of suitable data collection tools and processes necessary to collect the information required by the framework and other implementation issues.

The research was undertaken using a combination of research work related to the EU-project deliverables/work-packages and personal research of the researcher. The following sections of this chapter present the initial concept of the framework and the subsequent research actions to enhance the model.

4.2 Initial Conceptual Framework

It was discussed in Chapter 2 and 3 that literature provided the foundation for the conceptual performance improvement framework. The conceptual framework presented in Chapter 3 represents the researcher's perspective of informed performance improvement decision-making. The framework links several business elements that are interacting in the performance improvement framework (See Figure 16). This section presents in detail the literature sources that support the researcher's concept.

4.2.1 Business Objectives

At the top of the framework are the individual business objectives. Business objectives are used for providing a direction to the business efforts, and also for establishing alignment between strategy and performance indicators. The mechanism for aligning performance indicators to strategy is quite straightforward. Once the business objectives have been established and derived from the company's strategy, defining what the business should be measuring to ensure that these objectives are achieved is a natural follow on step. The mechanism behind the definition of performance indicators has been well documented in literature and it is covered by several performance measure and measurement system design methodologies (Neely, 1996; Bititci et al., 1997). This is not the innovative part of this research since the purpose is to base the performance improvement framework on performance measurement systems that have been already defined according to 'best' design guidelines. The development of the current performance improvement model is based on a performance measurement system already designed using a methodology developed within the EU TQM-Tile research project. A summary of the methodology is given in Appendix I. The methodology is based on the Cambridge process for performance measurement system design (Neely, 1996), and follows many 'best' design guidelines as discussed in Section 2.2.2. The appropriate definition of business objectives is very significant to the proposed performance improvement framework, since they are essential during the stage of determining a potential conflict with a lower-level action. Consequently, the inclusion of business objectives in the framework is one of the building blocks of the research, and a mechanism of deploying strategy throughout the business.

4.2.2 Performance Indicators

Each individual measure is defined by several characteristics important to the performance measurement system and includes amongst others: formula, definition, purpose, objective it is linked to etc. The characteristics used to define the performance measures during the research project are illustrated in Appendix II, and are a modification of Cambridge's performance measure record sheet (Neely et al., 1997). One of those key characteristics is the target value of the performance measure which is compared to the actual value. It is this comparison that can initiate necessary action for performance improvement and this is one of the key messages in performance

measurement (Neely, 1998). This is in accordance with the Deming cycle that was mentioned in Section 2.7.2.2. This notion is further supported and demonstrated by Zairi's Never-Ending Improvement Approach (Zairi, 1992) in the context of TQM and measurement for quality. Figure 19 illustrates the concept.

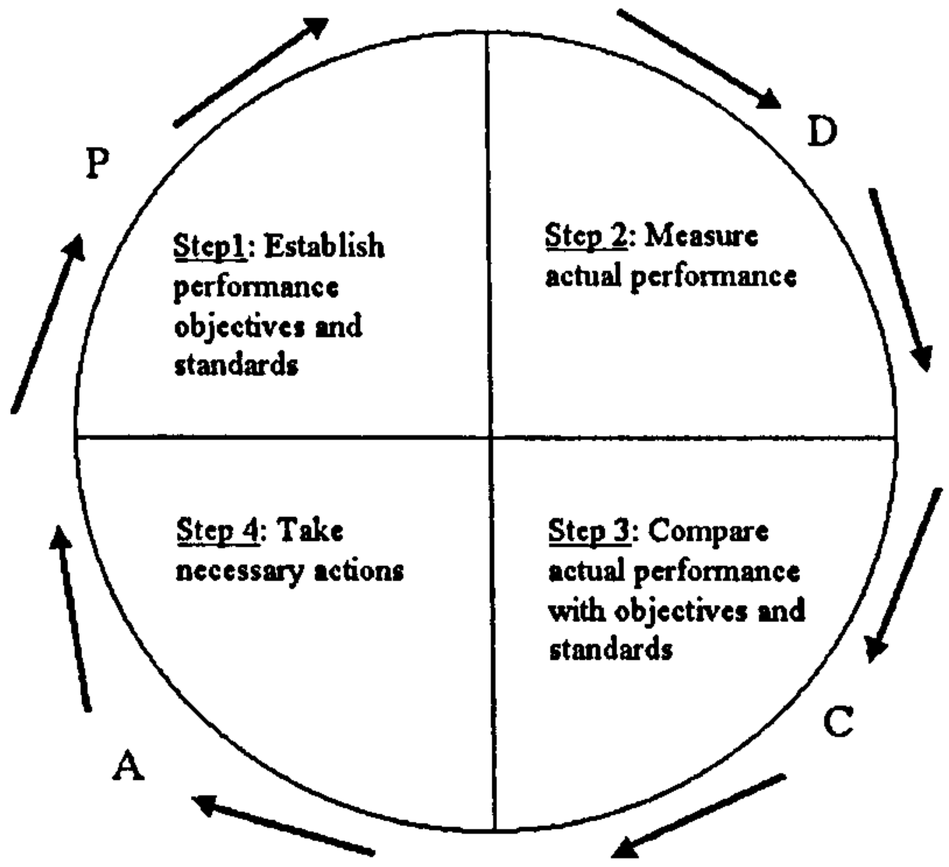


Figure 19 The never-ending improvement approach (Zairi, 1992)

An additional feature of the framework is that it fully supports the notion – and 'best' design practice – that performance measures should be derived from strategic objectives. That is another theme that was raised in Chapter 2 and is one of the building blocks of the research. The concept has been suggested in several instances in literature (Globerson, 1985; Maskell, 1989; Wisner and Fawcett, 1991; Kaplan and Norton, 1993; Bititci, 1994). This ensures the alignment of performance measures to the business strategy and contributes to its realisation, emphasising its industrial applicability.

4.2.3 Factors

The next step in the framework is the inclusion of possible factors that might affect the performance of one or more performance measures. These factors are analogous to the variables used in Burbridge's Production System Variable Connectance model that was discussed in Section 2.6. The assumption here remains that a change in a factor affecting a performance measure would result in a change of the performance level of the measure. Consequently, the deliberate and calculated manipulation of that factor can result in the desired change in the level of performance of the performance indicator.

The process of manipulating the factor entails initiating certain actions that will have the desired effect. These actions are at the bottom of the conceptual framework, and are a key feature of the research since it is through successful identification of the factors that affect a performance measure that the improvement action is deployed. To this end, it has been identified in literature that the effect that a factor can have on a performance indicator can be of three types (Suwignjo et al., 1997; Suwignjo et al., 1998):

- Direct (vertical) effect – is the combination of the effect this factor has on a measure of performance, its indirect effect and its self-interaction effect.
- Indirect (horizontal) effect – is the effect that other factors have on the performance measure at the same level through this factor.
- Self-interaction effect – is the way the factor affects itself.

Figure 20 illustrates the different effects:

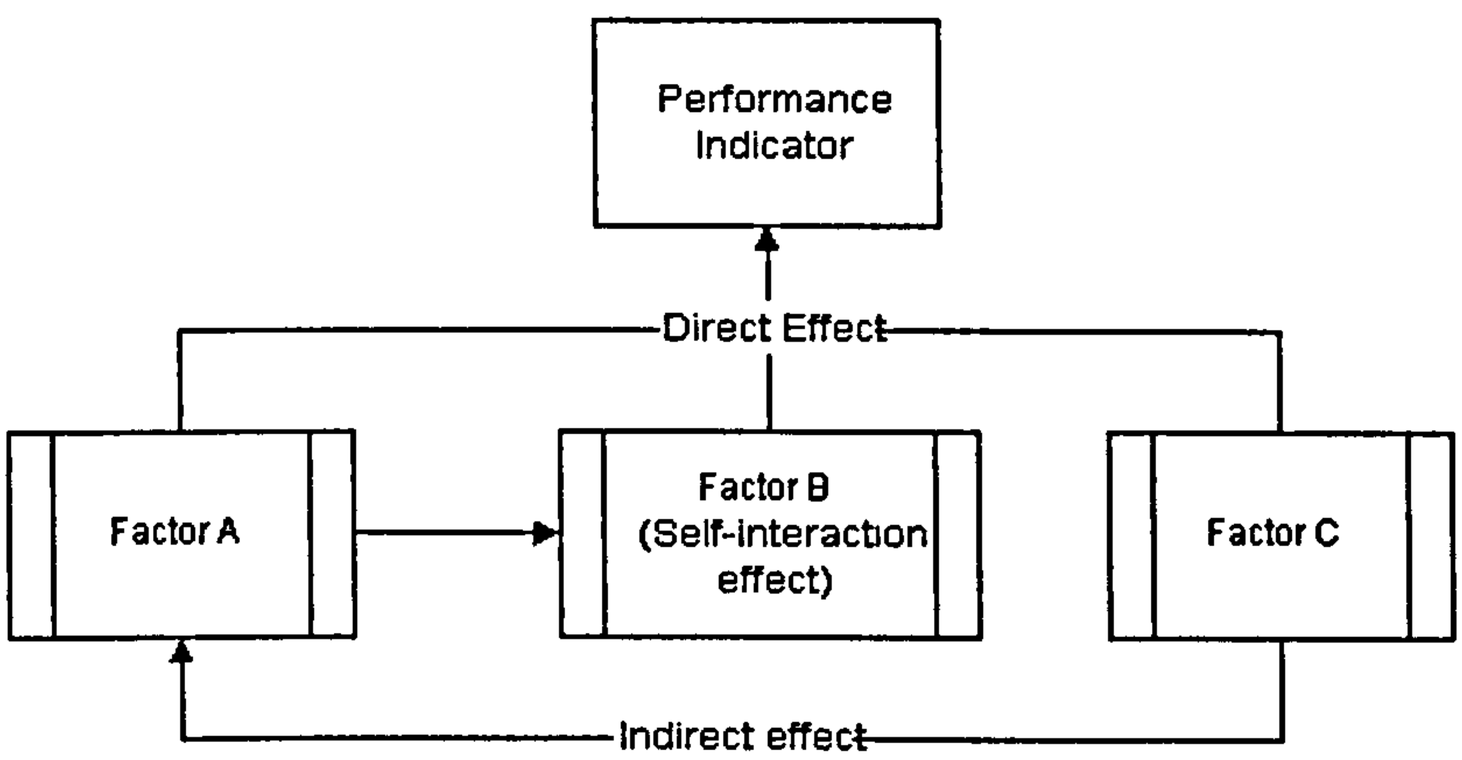


Figure 20 Factor effects on a performance indicator

4.2.4 Action Data

The actions that can be identified to alter the level of performance of an indicator will inevitably require certain resources. These resources may be physical (machines, materials), human, or information related resources. These resources are applied as constraints in the framework. This is important since it adds further realism to the number of actions that can be possibly taken under the current circumstances. This is a fundamental difference to other approaches such as (Kennerley et al., 1996), where potential improvement actions are best practices drawn out from literature. In a business

environment, quite frequently one will conclude that 'best practices' are not always the most feasible or suitable option. Moreover, ignoring current business circumstances might give a distorted picture of the business environment in which performance improvement is sought. The resources needed to undertake an improvement action are a point of consideration and provide an input to the consideration of trade-offs that was discussed in Sections 2.3.4 and 2.3.5, when making a decision. The decision should be based on the business strategy and the current circumstances of the business that these resources represent.

4.2.5 Links

As can be seen from the framework, throughout its structure, the concept of cascading measures is evident. This is consistent with the literature findings in Chapter 2 where it was supported by a number of authors (Son, 1987; Fry, 1989; Keegan et al., 1989; Blenkinsop and Davis, 1991; Wisner and Fawcett, 1991; Kaplan and Norton, 1996c; Bititci et al., 1997). This ensures that strategies are related to measures and that vertical links are present in the performance measurement system.

The concept of incorporating vertical and horizontal links onto a performance measurement system has been a key element on recent research (Bititci, 1995; Flapper et al., 1996; Rangone, 1996; Suwignjo et al., 1997; Bititci and Carrie, 1998; Suwignjo et al., 1998) and has been regarded as an essential part of performance measurement. The framework proposed in this research fully exploits this feature, which allows the unidirectional communication of objectives, measures, factors and improvement actions within a performance measurement system. The vertical links present in the performance measurement system act as the mechanism for tracing the impact of a low-level action to a higher-level objective or measure.

4.2.6 Hierarchy

The structure of the framework reflects literature findings discussed in Chapter 2. A hierarchical structure allows objectives and measures to be deployed to all parts of the organisation and actions can be consistent (Wisner and Fawcett, 1991; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c). This concept further supports and complements the previously mentioned element of cascading within the performance

measurement system. The proposed hierarchical structure has been used in practice by a number of leading companies in the field of performance measurement (Kaplan, 1996a; Edvinsson, 1997). It also allows for the appropriate metrics to be deployed to the appropriate part of the organisation. Consequently, the hierarchical structure provides the 'backbone" for the deployment of objectives and measures throughout the business.

4.2.7 Tools and Techniques

The next stage in the framework is the mechanism that assesses the strength of the relationships between objectives, measures, factors, and action to facilitate performance improvement. This is an important part of the research, since if one is to successfully manipulate the performance levels of a performance measure, then the information describing the impact it might have must be as accurate as possible. Additionally, the relevant knowledge has to be captured in a manner that supports the current practices of the business. In the context of this research, the literature supported the successful use of cause and effect relationships and the study of their strength (Kennerley et al., 1996; Suwignjo et al., 1997; Suwignjo et al., 1998; Kennerley, 2000) as well as their contribution to the process of taking improvement actions (Voss et al., 1994). In several cases the main tool used to capture interrelationships between elements was the matrix in a similar configuration to QFD's (Quality Function Deployment) "House of Quality" matrix. The elements to be assessed are placed in vertical and horizontal columns and their relationships assessed based on a scale. Table 4 illustrates the matrix based on an example between performance measures and factors that affect them.

	Measure A	Measure B	Measure C	Measure D	Measure E
Factor 1	+s	+s	--	--	-m
Factor 2	+m	-m	--	+s	--
Factor 3	+w	-s	+w	-s	+w
Factor 4	-m	-s	--	-m	+w
Factor 5	+s	--	+s	+m	+s

Table 4 Interrelationship matrix

As can be seen from the matrix the strength of the relationships is illustrated in a manner similar to QFD, which has been altered to reflect its use in the field of performance measurement. These are:

+s: Strong Positive
+m: Medium Positive
+w: Weak Positive
-s: Strong Negative
-m: Medium Negative
-w: Weak Negative
--: No impact

Matrices are constructed to assess the relationships between measures of performance, factors and measures, factor and actions that can be initiated by them, and finally actions and measures.

Matrices based on the QFD principle have been used successfully in capturing the relationships between factors and performance measures (Bititci, 1995; Kennerley, 2000). They also provide a simple method of capturing complex relationships that can be easily understood. Matrices allow for the deployment of business objectives and strategies through various levels of the business, thus promoting a more structured approach to CI programmes. This was an important consideration when selecting the tool to be used, since it met the requirements set out in the research objectives and hypothesis.

4.2.8 Information

The information required to assess the feasibility of each improvement action is gathered using the already existing measurement procedures in a company's performance measurement system. It is assumed that this information is present and available, and indeed this is one of the key assumptions stated in Chapter 1. Despite the notion having been supported in more than one occasion (Fuller, 1997; Drennan and Pennington, 1999), this is one assumption that was investigated through the research.

This is a concept that has been identified by a number of popular PMS design methodologies such as the Cambridge process (Neely, 1996) and the Integrated Performance Measurement System (Bititci et al., 1997). Both these methodologies rely heavily upon identifying people responsible for data collection, and improvement actions based on the data. This is done in an attempt to utilise the knowledge that people possess regarding the performance measurement system and integrate it with the performance improvement process. The current research is consistent with this concept. This is also one of the main assumptions underpinning the research that was stated in Chapter 1.

4.3 Framework Development Research Actions

The previous section discussed how theory, literature findings and the gaps identified came together in the forming of the initial conceptual framework. The following sections of the thesis expand on the initial framework by presenting the detailed development of the final framework. The development process is presented in a chronologically correct order to allow for the better understanding of the underlying logic during the development stages. The process aimed at addressing the main research questions through the framework development and the supporting literature review. A number of the actions are part of the researcher's work in the TQM-Tile project. These were made clear in Section 3.5. The other research actions are studies the researcher did for the advance of this thesis research. There are intellectual interactions with members of the TQM-Tile consortium. The ownership and responsibility of this thesis rests with this researcher.

4.4 Executive Information Systems (EIS) study

During the early stages of the TQM-Tile research, a detailed review of 74 commercially available Executive Information Systems (EIS) was conducted (Rigas and Fan, 1998). Executive Information Systems belong to a category of tools that represent leading edge support for business decision-making. These expensive systems support the analysis and presentation of business information through drilling down and connecting various existing business information systems. The market in which Executive Information Systems belong is wider than that of performance measurement applications. A number

of EIS support popular performance measurement frameworks such as the Balanced Scorecard and the EFQM model. The purpose of the review was to deepen the understanding of the current decision-making practices employed in the field of performance measurement. The study provided an up-to-date view of the decision support tools available to assist business management. Analysis of the data presentation and analysis techniques used in current EIS systems informed the researcher on the potential user expectations of managers. The main conclusions of the study set the early foundations of the framework and are presented below.

A hierarchical structure for representing a business performance measurement system was found in over 65 of the 74 packages reviewed. The advantages cited for choosing such a layout were that it allowed:

- A logical decomposition of measures and objectives.
- Explicit prioritisation of the performance measurement system elements.
- A view that was easy to understand and work with.

The study findings regarding the available data analysis and presentation tools showed that the current EIS focus on numerical and statistical analysis. None of the packages reviewed provided an explicit causality model in their structure even when they support performance frameworks such as the Balanced Scorecard and the EFQM Excellence Model. There were no mechanisms to support the expression of non-numerical relationships that are typical of management knowledge and 'gut feeling'.

The mechanisms to identify and develop improvement initiative were based on highlighting measurement indicators that fall outside the limits set as acceptable. A red-amber-green traffic light system was commonly used to highlight the condition of the indicators. EIS holds information on measurement owners and the typical scenarios suggested that the responsibility is assigned to the performance owners. There were no tools to assist with understanding the root cause of the problem nor trade-offs at a corporate level.

The study confirmed that there is a gap in the market of advanced management decision-making tools that this research can fill.

4.5 Performance Indicator Design Guidelines

The design of performance indicators was then studied. To enable the correct decomposition of performance indicators and link them to their relevant business objectives, the research had to determine thé common characteristics to ensure the consistency of the approach. The study of potential relationships between indicators would lead to a common set of relationship properties. It was necessary to understand what are the characteristics of a 'well' designed performance indicator from several different perspectives.

- Impact on the business – This meant understanding and establishing the characteristics that a performance measure should have to be able to represent the business state accurately and with respect to its strategy.
- Usability and Effectiveness – Understanding the characteristics a performance indicator should possess, to enable its effective use within the performance measurement system.
- Calculation issues – Understanding the numerical needs and properties of a performance indicator in respect to the previous point.
- Action issues – Understanding the mechanism with which a performance indicator should initiate action within a performance measurement system.

Collating the common characteristics allows the design of a consistent information model to capture the performance improvement knowledge.

The second part of the same study concentrated on establishing commonly accepted guidelines used throughout academia and the business community to design performance measures. This step also assisted in maintaining the business relevance of

the research. Both parts of the study were combined in a report into the design characteristics of 'well' designed performance measures (Rigas, 1998) and design guidelines. The study reviewed over 50 journal articles in the field and books that were considered as leading publications. The books and journal articles were selected based on their research value and was not a random selection process.

4.6 Performance Indicator Classification

Once the characteristics of the individual measures had been defined, the research focused on studying how these measures are classified within performance measurement systems. The goal of this stage was to establish the types of performance measures needed to construct a balanced performance measurement system that would enable performance improvement with a whole corporate perspective. For example, the study revealed that there is a need for input as well as output measures and forward looking as well as lagging measures. The research found the different dimensions of performance that should be included in a performance measurement system. These dimensions cover all the aspects of the business that should be considered when initiating performance improvement. Summarising the main output of the research the different dimensions of performance measures identified included:

- Financial and non-financial
- Cascading
- Specialised – i.e. reflecting their area of application
- Input and output
- Classified based on their decision type (i.e. strategic, operational, tactical)
- Aggregated – i.e. overall measures as opposed to partial
- Classified based on the measurement unit (financial, physical, dimensionless etc.)

4.7 Performance Measurement System design methodology

The next block of research development comes from the researcher's work in the development of the performance measurement system methodology that was one of the

key deliverables of the EU TQM-Tile-research project. A summary of the methodology is given in Appendix I. The methodology consisted of four major parts regarding the design of a performance measurement system:

- Design of the PMS
- Implementation and Operation of the PMS
- Review of the PMS
- Actions based on the review stage

This development stage lasted for 11 months and contributed to the development of the research in a number of ways.

This industrial research activity provided the overall confirmation of the earlier stages of the research regarding performance indicator design and classification as well as the structural issues discussed earlier.

4.7.1 PMS Design

The researcher contributed to the PMS design part of the TQM-Tile methodology development. Working with other researchers and industrial practitioners, this work provided an understanding of issues such as how the strategy and the deployment of strategic objectives could be achieved through the definition of performance measures. This work brought an added degree of 'realism' to the thesis research as the TQM-Tile methodology was planned to be a commercial package. The importance of a hierarchical structure to the understanding of the performance measurement system was adopted. The hierarchical structure not only helped the PMS designer by allowing for a logical decomposition of performance measures and objectives but also made it easier for the users to understand the links between the business strategy and the performance measurement system.

4.7.2 PMS Review

The author was responsible for the development of the review stage of the TQM-Tile methodology. The review stage concentrated on the reviewing process of both the performance measurement system itself and the review of the business performance.

The research during this phase concluded with the development of a framework for reviewing performance measurement systems. This stage assisted in identifying data collection tools and techniques used within the performance measurement system when using it, and more importantly the mechanisms used to initiate improvement actions based on the review. Figure 21 illustrates the resulting framework.

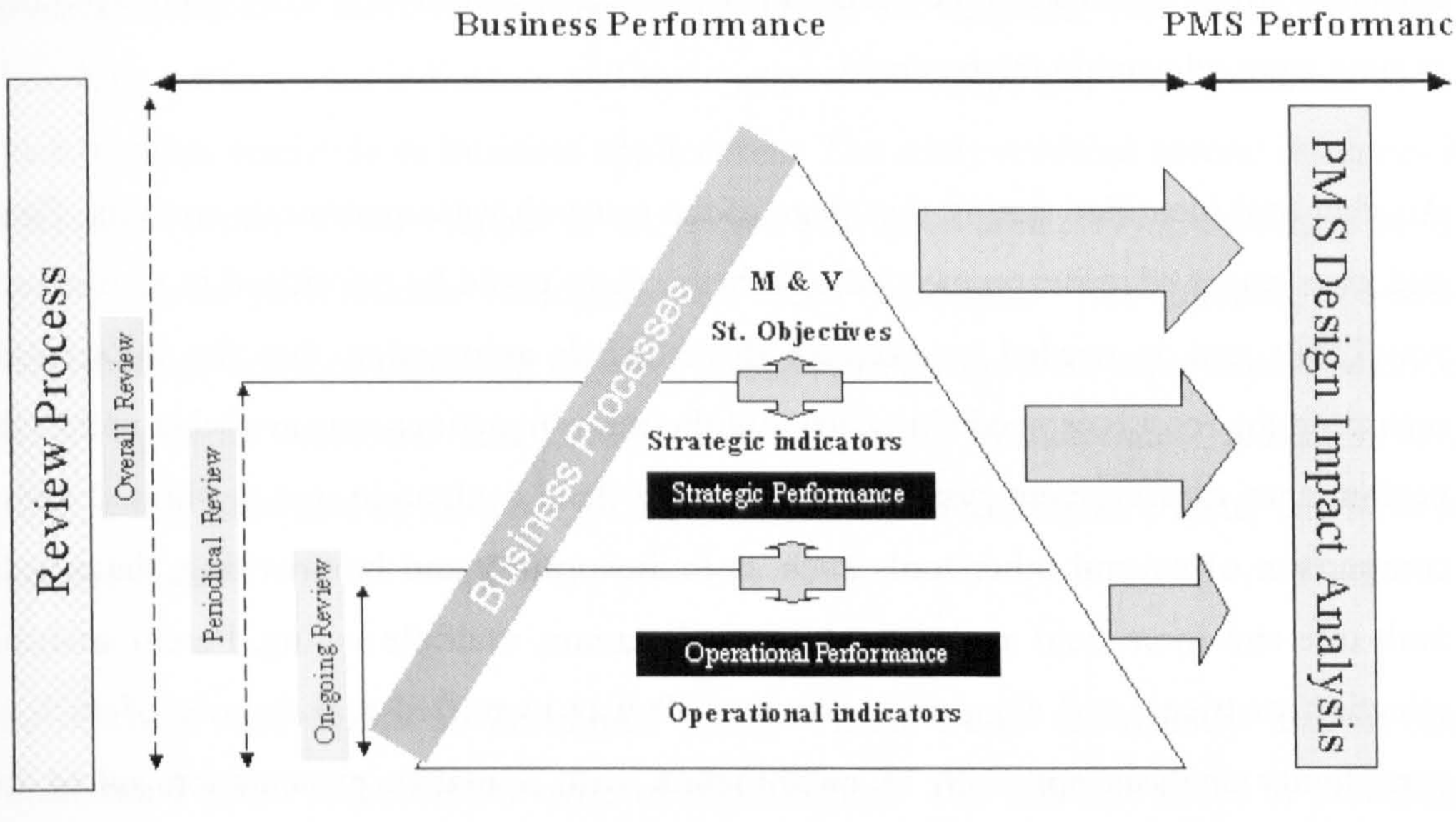


Figure 21 PMS Review framework

As can be seen in Figure 21, the framework brought together the concepts and research conclusions from previous stages such as the cascading of measures, classification based on the decision type (strategic and operational), as well as the decomposition of strategy and the company's mission and vision through the performance measurement system.

4.7.3 PMS Actions

The author was a key contributor to the PMS action workpackage. This stage also highlighted the potential of a continuous improvement approach to use performance management for improvement. By using only a reactive approach, i.e. improving a problem area, the focus for improvement tends to concentrate on the causes of that problem only and does not tend to consider the bigger picture.

The interrelationship matrix was identified as one of the most appropriate tools in the identification of improvement actions and the assessment of relationships between performance measures. It allowed for relationships to be presented in a structured way that enables the people involved to have a wider picture of the impact of one element to others. The prioritisation inherent in the mechanism is also an effective technique for selecting which actions to take based on several criteria, which at that specific moment in time were relevant to the business.

Another tool identified during this stage of the research was opportunity analysis. Goals and assessment of resources needed to achieve them could be prioritised in a structured way. This tool is needed to exercise the research assumption that the information regarding the resources needed to carry out the relevant actions was available within the performance measurement system of a company. Tool evaluation was performed with a comparison of several other tools such as brainstorming and brainwriting, datasheets, fault tree and force field analysis, Ishikawa diagrams, multiple voting, Pareto analysis, selection matrices, and suggestion schemes. It was identified that the use of such an opportunity analysis approach in combination with a matrix presentation suited the needs of the data collection and concept underpinning the research. Figure 22 depicts the basic concept underlying opportunity analysis.

Opportunity Analysis

Goals	Importance High Low	Ability to complete High Low

• Generating ideas by evaluating quickly a list of options against desired goals and available resources

Figure 22 Opportunity Analysis

4.8 Modelling Performance Indicator Relationships

The literature findings suggested the need for a framework that incorporates cause and effect relationships within performance measurement, this piece of work aimed at understanding how these relationships exist within the business. This involved a study into how performance indicators and their interrelationships had been modelled in the past in either academic or business applications. The study revealed several instances in literature (Bititci, 1995; Flapper et al., 1996; Suwignjo et al., 1997; Suwignjo et al., 1998) where performance indicators had been modelled. This included possible relationships between them and the way these relationships were represented. Matrices were used to represent and collect data regarding performance indicators and relationships and also as the basis for analysing the different impact a factor can have on performance.

A software test bed was developed using Visual Basic to visually analyse and understand better the different types of relationships. The test bed aimed at modelling fully the attributes of a performance indicator and by identifying the factors that affect it attempted at understanding their interaction. Figure 23 illustrates an example:

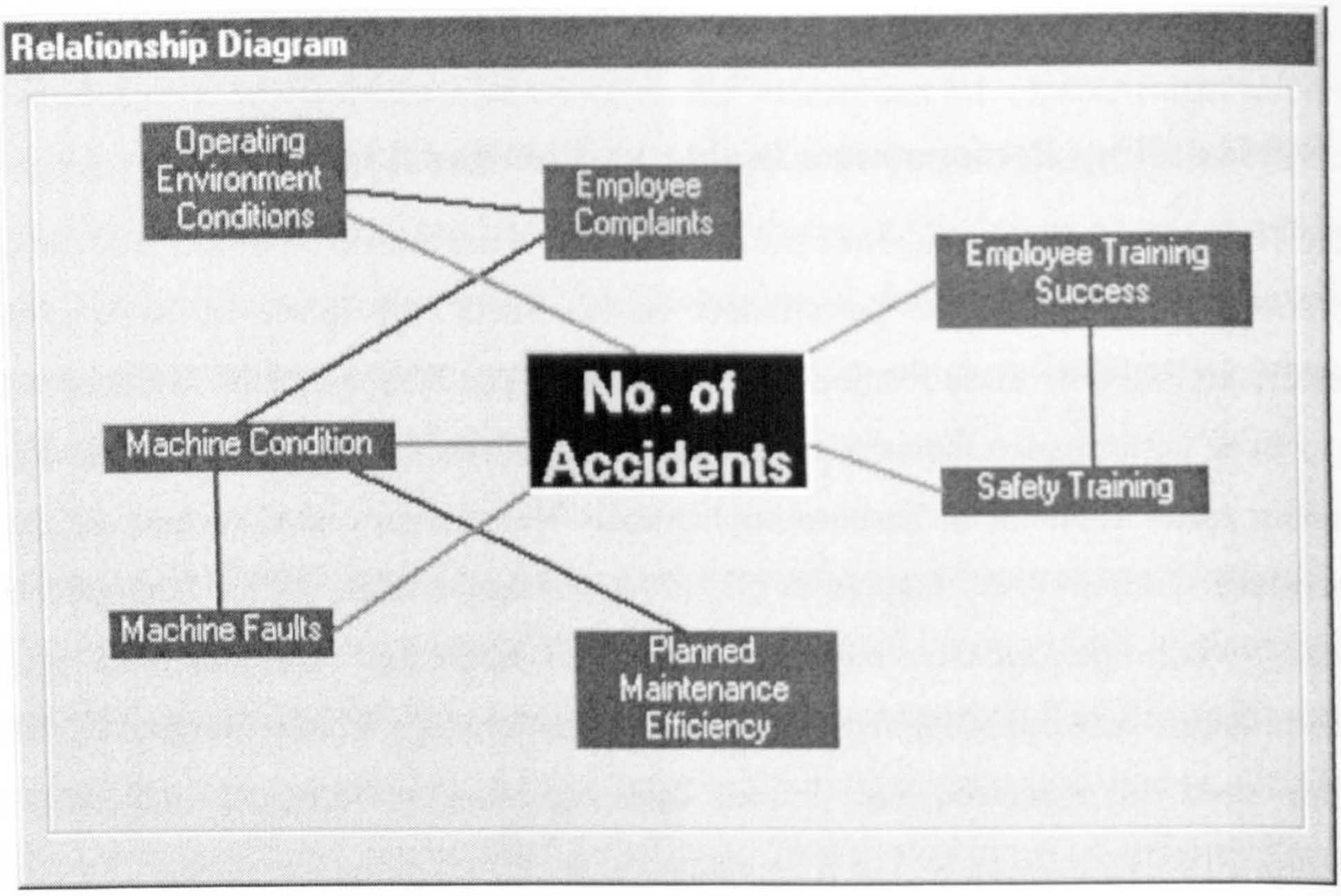


Figure 23 Performance Indicator Interrelationships

The above figure demonstrates the effect of possible factors on an operational performance indicator named "No. of accidents". As can be seen, the indicator is affected directly by factors such as "Safety Training", but the main significance was the observation that there are indirect effects on the indicator through different factors. For example, "Planned Maintenance Efficiency" has an effect on "Machine Condition" which in turn has a direct effect on the indicator "No. of Accidents". Thus any way to represent indicators relationships need to consider the different strength of the relationship, especially when attempting to collect data from a business performance measurement system.

4.9 Performance Indicator Interrelationships study

The researcher was the co-author of the TQM-Tile deliverable concerned with the development of a process for assessing relationships between performance indicators. This was a 9-month research module of the TQM-Tile project. The objectives of that part of the research were:

- To establish the viability and value of having quantifiable relationships within a performance measurement system.
- To establish the type of relationships useful to the process of performance improvement.
- Identify the information that needs to be collected to enable that and possible tools and mechanisms for doing so.

The study involved an extended literature review into the area of interrelationships within the context of performance measurement. Several models were identified including models that were in use by companies or models that had been partially implemented. It also involved interviews with companies in the ceramic tile sector of the TQM-Tile research project. One of the interesting conclusions of the research was that quantifying relationships between elements of performance was not always the preferred option. This was attributed to two reasons:

- Quantifying can prove to be a very difficult task that requires historical information, company data, and time and resources allocated to the task. Consequently, the task sometimes may become impractical.
- Managers prefer to have an assessment of the impact of a factor or an indicator on another one rather than an exact numerical representation.

Although managers were aware of different types of interrelationships within a performance measurement system, they realised that to enrich the decision-making process with that knowledge, there should be a structured process of incorporating them within it.

The study looked at ways of collecting data from the performance measurement system for two main reasons:

- Enabling the implementation of the interrelationship module of the TQM-Tile research since it would be a software based solution. This meant that the data collection techniques used would have to be accurate and effective.

- Establish whether the information required was firstly, available in the company and secondly, possible to collect.

This part of the work involved analysing the information collected from participating companies' information systems and carrying out interviews with the people involved. The conclusions of the research contributed to the development of the data collection forms discussed in Section 5.5.4 of this thesis. The research also concluded that the complexity of the relationships between factors of performance and performance indicators needs to be managed in a way that allows its manipulation towards a desired outcome. Summarising the achievements of the research is a model that attempts to illustrate the interrelationships between different aspects of performance and how these elements decompose into different quantities. Figure 24 illustrates the model:

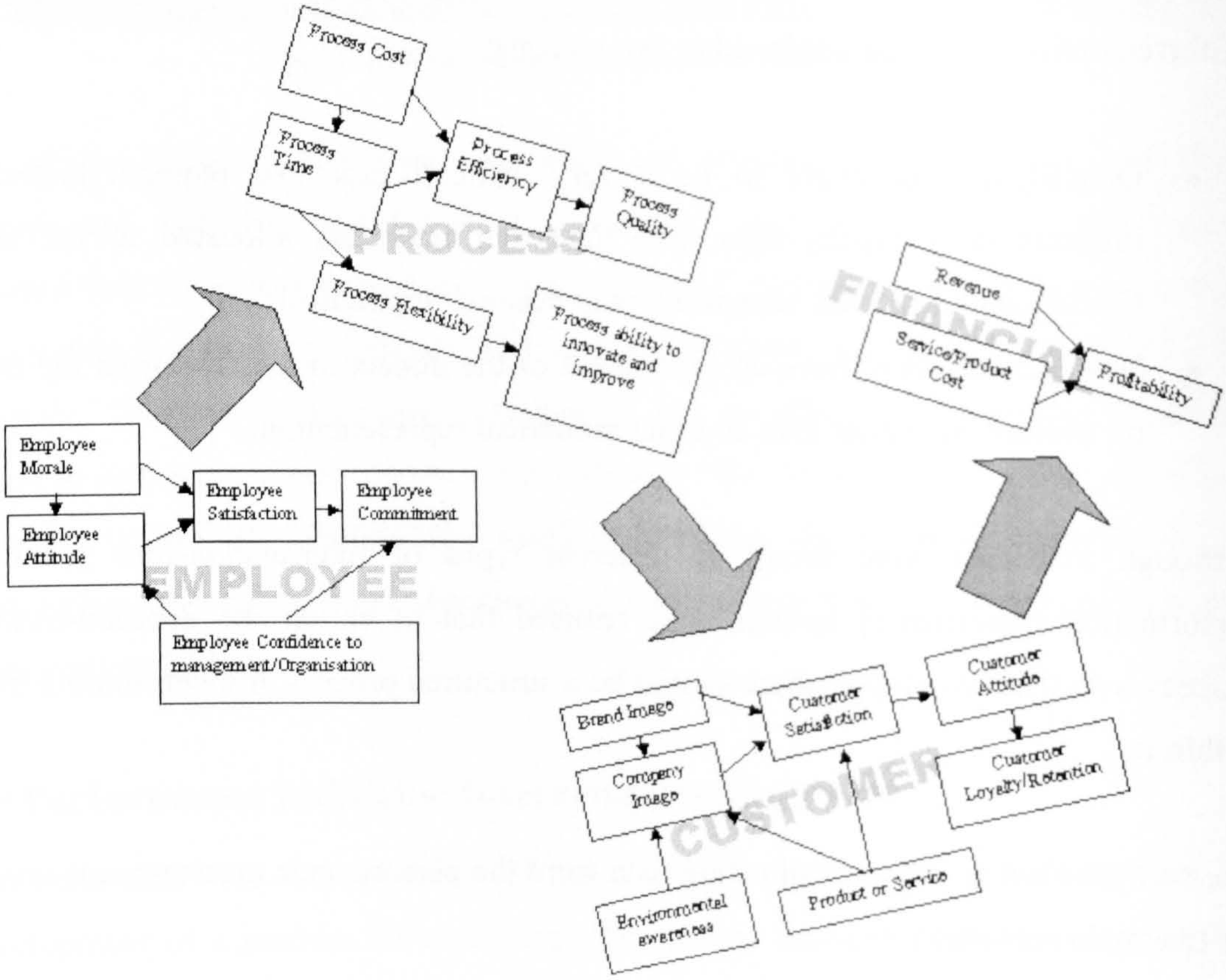


Figure 24 Generic interrelationship model

Figure 24 illustrates the flow of interrelationships between performance indicators in a performance measurement system through the perspectives of employees, processes,

financial and customers. It also illustrates the terms theses perspectives are defined in and might include. The model draws on both the EFQM and the Balanced Scorecard views of performance relationship. The development of the model was the result of an extended literature review and company data collection and analysis undertaken throughout the 9-month period of the specific work package.

4.10 Summary

This chapter reported the development of the theoretical concept of performance improvement framework. Each of the research steps is detailed and their contribution to the research was identified. The integrity of these steps provided the confidence of the construct validity in the doctoral thesis.

Chapter 5 – Empirical Development of the Framework

5.1 Overview

The empirical part of this research is to ensure the relevance of the results in this thesis through effective use of industrial input available to the researcher. The conceptual model of the performance improvement framework had been developed mainly from literature and interaction with practitioners. The TQM-Tile project provided the opportunity to obtain in depth industrial input to build the usability aspects of the framework. This also enhanced the external validity and the reliability of the research.

The next steps in the research methodology, as presented in Chapter 3 were designed to make systematic use of the industrial input through case studies with the industrial collaborators within the TQM-Tile project. The conceptual framework which was developed from performance measurement literature was complemented with the results from these case studies to enrich its structure and richness.

The construct and internal validity of the research as defined in Section 3.10, was based on the thorough treatment of data derived from literature. The empirical case study design was based on sound case study methods to ensure the continuity of validity.

This chapter presents the conduct of the case studies and shows how the results contributed to the enrichment of the performance improvement framework to ensure its suitability for industrial application.

The case studies had the three stages of 'case study design', 'single-case data collection and analysis', and 'cross-case analysis', as outlined in the next section.

5.2 Case Study Approach

The approach adopted during the case study phase of this research was based on the method provided by (Yin, 1994), which is shown in Figure 25. The elements of the case study method are discussed in the remainder of this chapter.

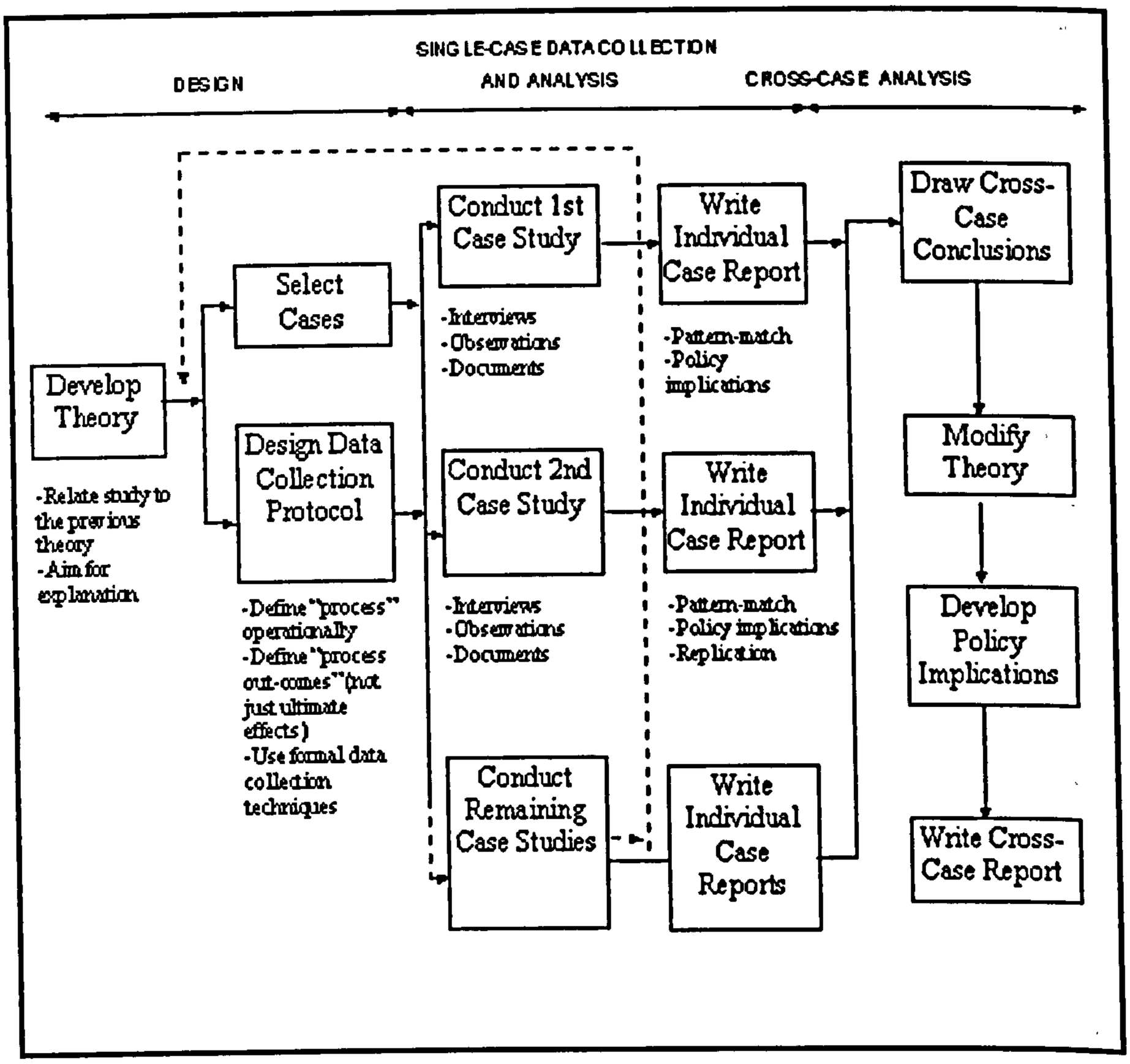


Figure 25 Case study approach (Yin, 1994)

The above figure illustrates an approach for conducting case studies that encompasses the stages of design, data collection and analysis and finally cross-case analysis. This approach is the result of research into the case study method (Yin et al., 1983). The theory development step was presented in Chapter 4, the next section presents how cases were selected and the design and data collection process.

5.3 Case Study Design

The main role of the case studies undertaken in this research were to:

- Obtain the necessary information to modify, if necessary, the conceptual framework. This relates to the main case studies undertaken in the research with two of the participating companies in the TQM-Tile project and contributed to

the development of the proposed performance improvement framework, and will be presented in the following sections of the thesis.

5.3.1 Case Selection

The sample for the case studies was 31 managers from the two industrial partners in the TQM-Tile project. Access to the managers was achieved through a number of visits. The two companies might seem a limited data environment, however, the researcher was able to maintain intimate contact with the companies and its staff because of their participation in the TQM-Tile project. This relationship of more than 31 months provided insights far beyond that could be possible without a long-term relationship. These companies also possess characteristics that were consistent with the literature findings regarding the application and development of performance measurement. Most importantly, these companies were prepared to allow for considerable access to information that would be invaluable to the research and would not be available under different circumstances.

Additionally, these companies have characteristics that were consistent with the assumptions to be investigated stated in Chapter 1:

- The quality of the information within a well-designed performance measurement system is good enough to allow the existence of explicit vertical links between different performance indicators. Both companies had used a 'good' practice PMS design methodology for developing their performance measurement system, hence complied with this assumption.
- Information regarding the resources needed to carry out a performance improvement initiative could be made available through the existing measurement procedures of a performance measurement system. Both companies had demonstrated the ability to improve by utilising knowledge already existing within their performance measurement system.
- The companies demonstrated characteristics that were accurate of a larger section of the targeted industries.

- The association between the research teams and the companies was deep enough to allow for accurate data collection.

Company A was in the tile manufacturing sector. It was one of the market leaders in their area and was operating on a make-to-stock basis. The company was ISO9001 certified and had won a number of prestigious awards for quality, design and innovation and over the last few years had invested in excess of €60 million to update their facilities and implement an effective environmental policy. The company exported 60% of their production to more than 70 countries around the world. Their annual turnover was in the region of €90 million of which 3% was invested in research and development. The total number of employees working for the company was approximately 700. The company had been involved in a number of initiatives aimed at the improvement of their business competitiveness and had embarked on a course towards full implementation of the EFQM Excellence Model.

Company B, was one of the major suppliers of Company A, and German based. The company belonged to the third largest group of companies in Europe in their sector, which again was the production of chemical based products. The company had four plants, one in Germany, one in Chile, one in Spain and one in Italy, each plant dedicated to the production of different product families. Company B was also ISO90001 certified and had a strong focus on innovation research and development. The annual turnover of the company was approximately €25 million, 80% of which came from exports all over the world especially Europe, China and Japan.

The companies were selected on the basis of being well established and successful in their areas and having a long experience in the field of performance measurement. Moreover, the companies' experience in the implementation of business improvement initiatives was an important factor in their selection. Both companies were in the process of implementing a multi dimensional Performance Measurement System. They were using the results criteria of the EFQM Excellence Model as a performance measurement framework with performance measures derived from four perspectives: Business Results, People Satisfaction, Customer Satisfaction and Impact on Society.

The companies had also identified their key processes within their business. The high-level process maps for the companies are shown in Appendix III.

The interviewees in the case studies were owners of the key business processes in these two companies.

5.3.2 Data Collection Protocol

(Yin, 1994) argues that a case study protocol "..is more than an instrument". He supports the notion that the protocol does contain the research instrument but also the 'operating instructions' on how to use it. It also includes all the rules and procedures necessary to use the research instrument. This research structured the data collection based on a protocol to ensure the validity and consistency of the data. To take into account of the cultural, business and language differences, the interviews were done using a format that was developed with the aid of the author, his supervisor and the research team based in Spain. The structure aimed at being comprehensive, accurate and to the point ensuring that all relevant information could be collected. The document of the protocol is given in Appendix VII.

As mentioned in Section 3.7 the case studies were aimed at establishing the validity of the framework and the relevant assumptions stated earlier in the thesis. Consequently, the framework was to be enriched with the information collected from the target companies and modified accordingly, so as to reflect actual operating practices. This would ensure the link between theory and practice and establish the foundation for the successful application of the framework. The structure and steps followed during the case studies were carefully designed to reflect the research needs and are as follows:

1. Initial interviews with management to collect information regarding the company's background and current status including:
    i. Company Strategy
    ii. Structure
    iii. Products
    iv. Financial Information
    v. Company Initiatives

2. Identification of the company's main processes and process owners as well as how these people are linked to the company's performance measurement system.
3. Performance Measurement System
    a. Measures of performance used throughout the company and the way these measures were defined. This includes:
        i. Targets
        ii. Formulae
        iii. Data Collection
        iv. Frequency
        v. Action
        vi. Ownership
        vii. Tools used
    b. Relationships between performance indicators and overall business performance including:
        i. Impact of Actions
        ii. People Involved
4. Performance Improvement
    a. Availability of Information
    b. People Involved
    c. Procedures
    d. Tools Used
    e. Achievements
    f. Resources

The interviews were not the only source of evidence used in the case studies. The author also examined whether the results from the interviews were supported by evidence in the form of documents and information system records found in the companies. (Yin, 1994), suggests that the use of multiple sources of evidence in case studies, allows the investigator to address a "...broader range of historical, attitudinal, and observational

issues". However, he goes on to support that the major advantage of such an approach is the development of converging lines of enquiry in the form of a process of triangulation.

5.4 Data Collection and Analysis

This section of the thesis describes the undertaking of the actual case studies that were used to validate and modify the conceptual framework. The case studies were also used to identify the data collection methods to be used in the final framework.

5.4.1 The Case Studies

These case studies were carried out using a carefully planned and prepared process. The preparation involved frequent contact, via telephone or e-mail, with the companies' management to ensure that they were absolutely clear on the objectives and structure of the case studies. That was an important issue, since due to the distance involved, there would be limited opportunities for the researcher to repeat the case studies if something went wrong. The timing was significant since the aim was to achieve maximum information collection with minimal disruption to the companies operations.

To support the research, a number of colleagues from one of the participating universities research team assisted in the interviews. The reasoning behind the involvement was:

a. The research team had very strong links with that specific industry and had recently completed a five-year project with a large number of companies. The project resulted in a generic model of performance indicators and processes widely used in the sector, thus their deep knowledge could be helpful to the research.
b. It was felt that the presence of persons from that specific participant could 'ease' and help in overcoming potential communication problems or cultural barriers that could emerge throughout the case studies, and could potentially have a distorting effect on the results.
c. There was a concern regarding the input of the companies' in the framework in that it could become too company specific. For instance, it could become biased

towards the case studies undertaken in these companies. It was felt that the presence of people that had been involved in long-term research in the sector and had great experience in the operating practices of companies within that sector could assist in alleviating any such discrepancies.

The majority of the interviews were of the focused-type as was described in Section 3.6, which is a type of semi-structured interview. Complementing the interviews was supporting documentation as well as direct observation of the researcher of several operational practices within the companies. That step was consistent with maintaining the construct validity of the research as mentioned in Section 3.10. The objective of this phase was the understanding of the inner workings of the companies and the verification of the interview results.

The interviews, documents and information system record reviews took place over a period of one week for each company. Further telephone or e-mail enquiries followed where all the necessary information was not collected or clarification was needed. A total of 31 managers were interviewed during that period ranging from senior management, to middle and lower level managers and or process owners. This was split in a total of 8 senior managers and 23 from lower management levels. In the case of where a process owner was not the performance indicator owner for the indicators in that process, then it was ensured that the indicator owner also participated in the interview to enhance the validity of the results. The presence of senior management in some interviews together with lower level management helped to convey a positive image of commitment to employees and thus could contribute to the facilitation of data collection. The majority of the information was collected using face-to-face semi-structure interviews. The structure and layout of these interviews are given in Appendix VII.

5.4.2 Write Individual Case Report

(Yin, 1994), suggests the writing of the individual case reports as the exercise for pattern matching and theory development. In the context of this research, the report

from each manager was already in the structure of the interview protocol. The interview script for each manager forms the individual case study report.

5.5 Cross-Case Analysis

The cross-case analysis following the case studies is an important step of case study research and is also one of the more difficult ones. (Yin, 1994) suggests that it might be due to the lack of deep research into the practice, with the notable exception of a few authors (Miles and Huberman, 1984; Wolcott, 1990). The conclusions of the analysis of the results are discussed in the next section.

The detailed results of the quantitative part of the case studies are in Appendix IX, the summary of analysis is in Appendix VIII. The following sections present the major highlights of the results in the order of theory building of this research.

5.5.1 Performance Measurement

One of the key findings from the analysis of the results was the approach the companies had adopted towards performance measurement. The companies had adopted an effective and positive attitude towards performance measurement that was being used to drive their business forward. Both companies were fully implementing the TQM-Tile project's PMS design methodology that was bringing together the concepts of process management and performance measurement, so the companies had demonstrated a relative maturity in the field.

Both companies had adopted a structured approach to the definition of their strategic and operational indicators with clear procedures and ownerships. This was reflected in their performance measures and the way they were being used. Although the above results indicate a mature approach to performance measurement, there were some direct observations during the company visits supporting that sometimes the definition of indicators followed an ad-hoc approach rather than a structured one. The reason was, according to the managers, they were not absolutely clear about the strategic relevance of each measure. The lack of strategic focus on measurement contributed to the lack of alignment of actions to business strategy, a notion supported extensively in literature (Globerson, 1985; Dixon et al., 1991; Kaplan and Norton, 1992). Despite this being

observed in only a small proportion of the performance measurement system, an interesting observation is that the strategic relevance of performance measures is not just a function of the design of the company's PMS. This implies that there might be other factors affecting this, a concept which is currently being researched (Waggoner et al., 1997).

The case studies confirmed the validity of the need to align the development of performance indicators towards business objectives, and also show that the discipline to do this is not always practiced.

5.5.2 Performance Improvement

Both companies tended to initiate improvement mainly on a reactive basis, i.e. when there was a problem. It was supported and observed that the people involved in the improvement process were very knowledgeable of the possible actions they could take and that was something the companies were taking advantage of. There were a number of tools used for process control such as control charts, affinity diagrams, and in general the problem solving ability of the company seemed to be quite effective. On the other hand, there was a complete lack of understanding of the strategic impact that any low-level improvement action might have on the company. The majority of managers felt that strategic alignment when taking improvement actions was very important, especially in the midst of the business improvement initiatives that the companies were undertaking.

It was concluded that the improvement action taking skills in the company could be used to their full extent by the use of the framework developed in this research and the managers recognised that this would contribute to structuring their performance improvement process.

This confirmed the missing link between performance measurement and improvement planning. The form of linkage as presented in the conceptual framework was accepted as an effective way forward.

5.5.3 Factors of Performance

There was very little evidence of a formalised structure of understanding of the factors that affect performance measures within the companies' performance measurement system. Additionally, there was evidence that improvement actions were taken on an "intuitive" basis and many a time managers during the interviews acknowledged that they were not always clear of the impact these actions might have on the overall business performance. During the interviews, a number of managers recognised the benefits of having a structured approach that would help them understanding the impact of factors that affect performance. They also acknowledged that implementing such an approach would enable them to take more informed decisions. Moreover, they recognised that that would widen their understanding of the overall performance implications in the business. Consequently, it was generally agreed that measuring performance at low-levels and understanding how this affects the higher levels strategic objectives could be of benefit to the companies. It was concluded that understanding the relationships between the elements of the company's performance measurement system, could contribute to the decision making process on a continuous improvement basis and in alignment with the business strategy.

This confirmed the need to develop the approach to link the factors of performance. The approach in the conceptual framework was accepted as valid.

5.5.4 Tools and Framework

The companies positively recognised the value of using the special knowledge inherent within their people to drive improvement actions and acknowledged this as an asset. This effective way to capture and represent the knowledge as relationships was explored.

The companies identified four different major categories of resources incurred when taking improvement actions. These were:

- Time
- Cost
- Human Resources

- Information

The inclusion of the above categories reflected the competitive priorities of the companies and is consistent with the literature findings in Section 2.3.3. These four categories are not complete and can be expanded to include others reflecting the current priorities and circumstances of the company. One of the initial assumptions found in the framework was the belief that managers would be able to reasonably quantify the resources that are needed to undertake a certain improvement action. While managers were actually very effective in identifying resources needed for each action, it became evident during the interviews that quantifying the resources was a difficult task and in some cases undesirable. The most suitable way was to estimate the resources needed to initiate an action based on a scale of High, Medium or Low. This was decided for two reasons. Firstly, it was quite difficult to estimate the numeric value of a property, and secondly, it ensured that the framework had the flexibility to be applied to a variety of companies. For instance, high resources for one company might be medium for another one, thus the framework needed to reflect that rather than opting for an absolute predefined scale. The approach decided had already been demonstrated successfully in the literature (Tempest, 1998). The above key findings in combination with the literature review came together in the development of a form to collect such data to populate the framework. The form is in Appendix V and Figure 26 illustrates a cutout view of the form.

Factor Name	Unit of Measurement	Relevant Actions	Time element	Cost element	HR element	Information element	Authorisation level	Control
1...		A1	H M L	H M L	H M L	H M L	0...4	Y N
2...		A2	H M L	H M L	H M L	H M L	0...4	Y N
3...		A3	H M L	H M L	H M L	H M L	0...4	Y N
4...		A4	H M L	H M L	H M L	H M L	0...4	Y N

Figure 26 Cutout view of the factor and action data collection form

The definition of authorisation level at the end of the form uses a simple numerical system that the companies were using to distinguish between decision authorisation levels within the company. If the person acting upon an indicator had an authorisation level lower that needed to initiate a specific action then this person could not carry out

the action. The final column in the form represents whether the company had any control over that specific factor or not. In cases where the answer was no, then one should consider why factors we do not have control over are included. The fact was that this could provide managers with a better picture of which factors can potentially affect a performance indicator. All the above elements were valid considerations that were included in the decision making process to reduce the number of possible outcomes, thus optimising the result.

Another key theme that emerged from the case studies was the process of identifying the factors that affect performance. Initially, it was believed that a simple semi-structured approach would be enough to stimulate managers into identifying the factors that affect performance. However, during the course of the interviews it emerged that a structured approach would be much more appropriate. Indeed, it was decided that a cause and effect diagram would facilitate the task considerably. The structure of the cause and effect diagram was based on BS7850 (BSI, 1992) guidelines for quality improvement, where the use of cause and effect diagrams is described to capture the interactions amongst factors (causes) that affect a process (effect). These can include:

1. Data and Information system
2. Monetary
3. Environment
4. Hardware
5. Materials
6. Measurements
7. Methods
8. People
9. Training

The proposed procedure includes defining the effect (in this case the performance measure) clearly and objectively and then defining the main categories of possible causes (factors). The structure is illustrated in Figure 27.

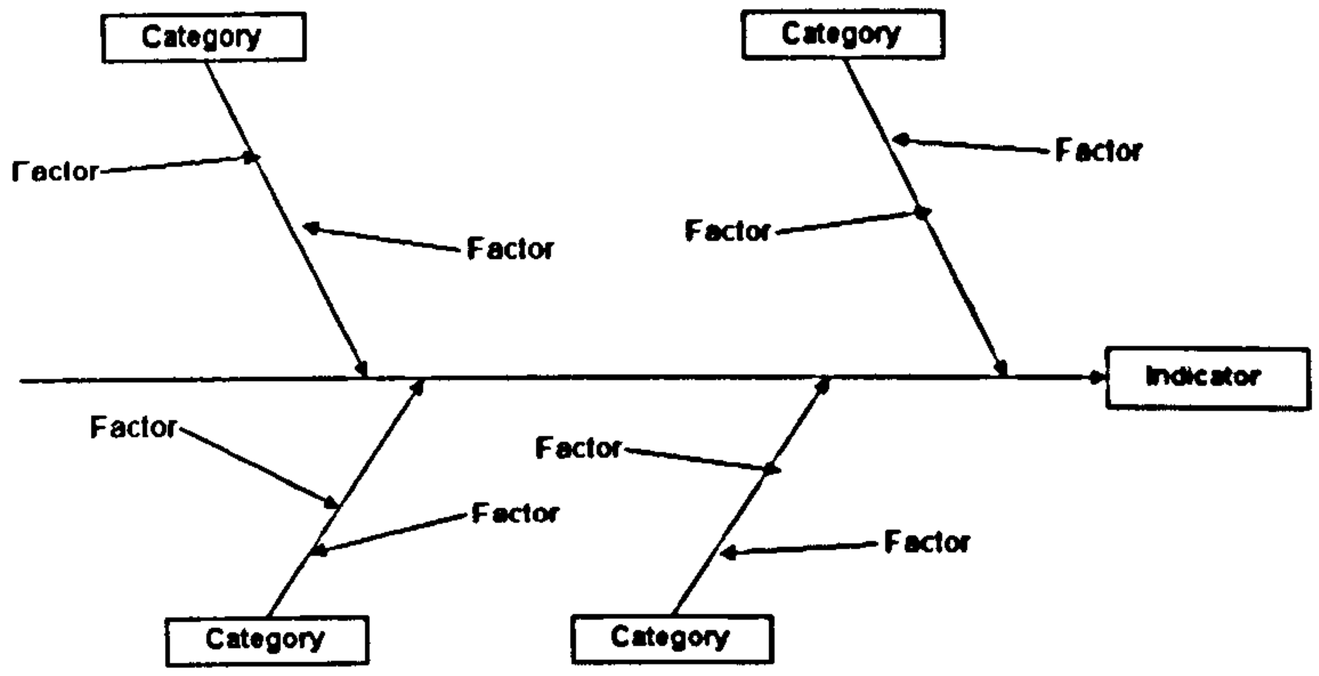


Figure 27 Cause and effect diagram

The diagram assists in identifying factors from different categories that might affect a performance indicator. As (Suwignjo et al., 2000) state, it is important to include as many factors affecting performance as possible, to ensure valid results.

The suggested approach aimed at achieving performance improvement by using a type of constraint solving reasoning. The inclusion of constraints was chosen because they offer flexibility, incremental change potential and co-operative mechanisms when included in solution 'algorithms'. The resources needed for each improvement action were incorporated as constraints in the decision making process, to offer increased flexibility and also to act as a 'filter' further reducing the number of possible actions to consider.

5.5.5 Interview Discussion

There were a number of key findings drawn from the case studies that were relevant to the research:

1. There was an evident lack of understanding of the relevance and impact of elements of the performance measurement system on higher-level strategic objectives. However, the benefit of having such a structure in place was recognised and was considered to be very important to the business strategy.
2. There was no explicit or structured approach to the understanding of factors and how they can affect business performance. Nevertheless, the companies

recognised the benefits of such an approach and how it could contribute to the understanding of the process of achieving performance.

3. There was no structured approach to performance improvement within the context of performance measurement. For example, a lot of the actions taken were not at all strategically aligned with the overall business strategy through a structured framework. This was acknowledged and was widely believed to lead to localised optimisation.
4. The resources needed to undertake an improvement action were not usually considered until after the action had taken place. In the cases where justification was considered before the improvement action, this was usually done on a financial basis and applied only to a specific indicator. Nevertheless, the companies were quite successful in estimating resources and utilising the knowledge of the people involved in the improvement process.

The case studies revealed the need for better understanding of the strategic relevance of measures at low-levels, a notion that was discussed in Chapter 2 and was supported by several authors (Beischel and Smith, 1991; Feurer and Chaharbaghi, 1995; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c). They all suggested the need to have a hierarchy of measures at different levels in the business. The benefits of such a hierarchy would be an improved understanding of the strategic relevance of low-level measures and an increased ability to focus improvement on suitable areas of performance.

Another conclusion that emerged from the case studies was the way performance measures were used throughout the companies. Despite the companies following a 'good' practice PMS design methodology, sometimes it was evident that measures were being used for control rather than improvement. The latter is a notion supported by literature (Lynch and Cross, 1991; Zairi, 1992) and (Zairi, 1992) suggests that this might be due to the different priorities between management and employees. He also supports that employees should be given more freedom to innovate and improve, and management should provide a suitable environment to facilitate that. This is an important point, since as it was discussed in Section 3.4.6, one of the potential benefits of the framework is the ability to undertake improvement initiatives at lower levels

hence improving responsiveness and flexibility. Consequently, to enable such an approach there must be a positive environment in the company in which employees are allowed to do so. As (Zairi, 1992) states: "Managers should provide an environment conducive to improvement efforts".

On the same note, a number of managers recognised that the concept required a reasonably complex data collection process, thus management commitment was regarded as essential.

The findings from the case studies also indicated that the proposed performance improvement framework would help in the understanding of the implications of improvement actions. Several interviewees supported this point and commented that it could potentially improve the efficiency of their decision-making in that it would be very useful to be aware of the impact of an action in other areas of performance. Additionally, allowing for the resources needed for each action to be included in the framework could enhance the optimisation ability of the business as well as reflecting better the current business circumstances.

5.5.6 Modify Theory

The case studies resulted in several modifications/enhancements to the proposed framework. The interviewees identified four key areas from which resources could be incurred that had the most important impact on the business: Time, Cost, Human Resources and Information needs. It is evident that these four are interrelated, i.e. Human Resources will incur Cost, but it was felt that these four properties represented the business more accurately in terms of their competitive priorities. One of the main modifications to the performance improvement framework was the decision to use a High (H), Medium (M), and Low (L) scale, when assessing the resources that could be needed to carry out an improvement action. As it was discussed earlier this enhanced the frameworks applicability and flexibility rather than using a pre-defined scale.

Finally, it was identified that a suitable way of identifying factors affecting performance would be the use of a cause and effect diagram. The use of such a diagram to identify factors affecting performance has been successfully used in literature (Bititci, 1995) and

constitutes a systematic approach. The cause and effect diagram is extremely helpful in organising logically causes and effect and is quite simple in that relationships are illustrated as simple causal ones. Nevertheless, they do have certain drawbacks such as the inability to show the interrelationships between causes and the lack of an explicit view on how causes and effects can feedback on each other (Flood, 1993). However, for this specific application they were considered appropriate since the need was for the categorisation of factors that can affect a performance indicator, to facilitate their identification.

5.6 Summary

This chapter discussed how the input from the industrial case studies contributed to the development of the performance improvement framework. It also presented the case study approach chosen. The case study results were discussed as were the conclusions drawn from them and their relevance to the research. The validity and usefulness of the model were also investigated through the case studies and also the potential benefits of a structured approach towards factors, actions and measures of performance.

The case studies results supported the literature findings and the need for the current research. They also highlighted the lack of understanding of the factors that can affect performance and their impact on the overall business. Moreover, the results supported that better understanding the specific implications of improvement actions could be of benefit to the business. The above findings support the need for the development of the proposed performance improvement framework, so that more informed decisions can be made.

The framework was enriched with information based on the case study results, to reflect usability and practicability issues that were anticipated to be found in a business environment, as well as several tools were identified to assist the population of the framework. Table 5 summarises the work carried out during the research steps in both Chapters 4 and 5, and how it contributed to addressing key research issues such as:

- Structure of the framework.

- Matrix structure and appropriateness.
- Possible to capture the needed information to populate the framework?.
- Use of the matrices for decision making.
- Level of expertise needed to use the model.

Research Contribution / **Research stage**	Structure of framework	Matrix structure and appropriateness	Information needs of the framework	Use of matrices for decision making	Level of expertise needed to use the model
Executive Information Systems review	✓				
Performance Indicator (PI) design guidelines	✓		✓		
Performance Indicator (PI) Classification	✓		✓		
Research Deliverable (DL9) – PMS Design Methodology	✓				
Research Deliverable (DL9) – PMS review process	✓		✓		
Research Deliverable (DL9) – PMS Improvement Actions		✓	✓	✓	
Indicator Interrelationship Analysis		✓	✓	✓	✓
Company case studies		✓		✓	✓

Table 5 Research action

Chapter 6 – Validation

6.1 Overview

The validation of the proposed performance improvement framework is a process that is based on the research objectives and the nature of the theory building approach. The aim of the validation part of the research is to investigate its applicability and usability in a company covering the research application requirements. As it was stated in Chapter 3, the theory building approach followed reflects the current theoretical state of the field but it is also an interpretative exercise designed to produce a theory for later testing. Chapters 4 and 5 demonstrated how the theoretical background and the case study findings came together in the development of the framework. The validity of the research results was ensured in every step of the research methodology and development.

This chapter aims to establish the applicability and usability of the performance improvement framework and presents its trial implementation in one of the business processes of the performance measurement system of one of the participating companies.

The chapter is divided in two main parts. The first part explains the process and the tools to gather performance information and the knowledge of the interrelationships to build up and populate a performance improvement framework. The different ways the framework could be used are then elaborated.

The second part of the chapter reports on the exercise of applying the process and the tools to the Integral Logistics Process of one of the industrial partners in the TQM-Tile project. The results and the feedback confirm the industrial relevance and applicability of the research work.

6.2 The Process to Populate the Performance Improvement Framework and its Application

As it was stated in Chapter 1 the main objective of the research was the development of a framework that identifies performance improvement actions that are in alignment with the organisational strategy. The framework takes into account the impact an action intended to improve a measure of performance has on other measures and business objectives and incorporates this information into the decision making process. The resources needed to take these improvement actions are applied as constraints to the process, thus enabling further optimisation.

6.2.1 Application Boundary

The application of the proposed performance improvement framework has certain pre-requisites. These requirements, in the form of information and performance measurement structure, form the application limitations of the framework. In particular, the organisation needs to already have:

- A performance measurement system with explicit vertical links and a hierarchical structure.
- Explicit links between business objectives and performance measures.

6.2.2 Performance Indicator Form

Based on the literature findings and the case study results discussed in the previous chapter, a form was devised to facilitate the data collection part of populating the framework. The form follows a fairly standard format in performance measurement literature and is presented in Appendix IV. It contains information regarding the company's performance measures and includes:

- Name of the Indicator
- Type of Indicator
- Objective(s) the Indicator is Linked to
- Owner of the Indicator
- Authorisation Level of the Person (This is a company specific mechanism)

- Purpose of the Indicator
- Factors that Affect the Indicator

The form was designed to collect information that is already present in a 'well' designed performance measurement system and does not require any additional measurement procedures to be put in place.

6.2.3 Populating the Framework

The population of the framework is split into three parts. The performance data collection stage, the factor and action analysis stage, and the matrix creation stage. Each of these stages will be presented in the following sections.

6.2.3.1 Performance Data Collection

During the performance data collection stage, information is collected regarding the company's performance indicators using the form shown in Appendix IV. The cause and effect diagram is also used to identify the factors that affect each indicator. The people involved at this stage can be the performance indicator owners, owners of the related process or people that can act upon the performance indicator. The output of this process is information regarding the company's performance indicators, their link to appropriate business objectives and the factors that can affect them.

6.2.3.2 Factor and Action Analysis

During the second stage of the process, information is collected regarding the relevant actions that can be initiated by each factor, including the resources that these actions might incur. The information is collected using the form shown in Appendix V. The result of this stage is a set of actions that can be initiated by each factor, as well as the resources needed to take each action, and the authorisation level needed. The form also includes information regarding whether there is any control over several factors, i.e. a surge in demand is something out of a company's control, but nevertheless can be a contributing factor to stock management.

6.2.3.3 Interrelationships Matrix Creation

The final stage of building the framework involves the creation of matrices depicting the interrelationships between the following elements:

- Indicators and Indicators
- Factors and Indicators
- Actions to Factors
- Actions to Indicators

The format used to create these matrices is the one shown in section 4.2.7 and illustrated in Table 4. The result of this stage is a set of matrices that show the relationships between the previously mentioned elements within the performance measurement system as well as the strength of that relationship based on the following impact scale: positive strong (+s), positive medium (+m), positive weak (+w), negative strong (-s), negative medium (-m), negative weak (-w), no impact (--). These matrices form the basis for the decision making process regarding the performance improvement activities. Table 6 illustrates the various steps involved in building the framework as well as the tools used and the people involved.

	Tools	People	Methods	Output
Performance Data Collection	a. Data Collection Form b. Cause and effect diagram	Performance Indicator owners, process owners etc.	Interviews, workshops	Performance Data
Factor and Action analysis	Data Collection Form	Performance Indicator owners, process owners etc.	Interviews, Workshops	Factors and actions identification, resources identification
Matrix Creation	Matrices	Performance Indicator owners, process owners etc.	Interviews, Workshops	Populated Matrices

Table 6 Building the framework

6.2.4.4 Linking the Matrices

Once the steps have been completed the resulting matrices depicting the relationships present within the performance measurement system are used to identify the appropriate performance improvement actions. As was discussed in section 4.2.7 the layout of the matrices helps in illustrating the impact of one element of the performance measurement system to others. For example, it is possible to show the impact one indicator has on other performance indicators within the performance measurement system. Thus, when taking performance improvement actions to increase the level of performance for that indicator, it is possible to assess the impact these actions will have on other performance indicators as well. The decision making process is enriched with information regarding the impact of low-level actions not just to higher level objectives but also horizontally to other areas of the business. Figure 28 illustrates how the matrices are linked together in a logic structure to facilitate strategically aligned performance improvement.

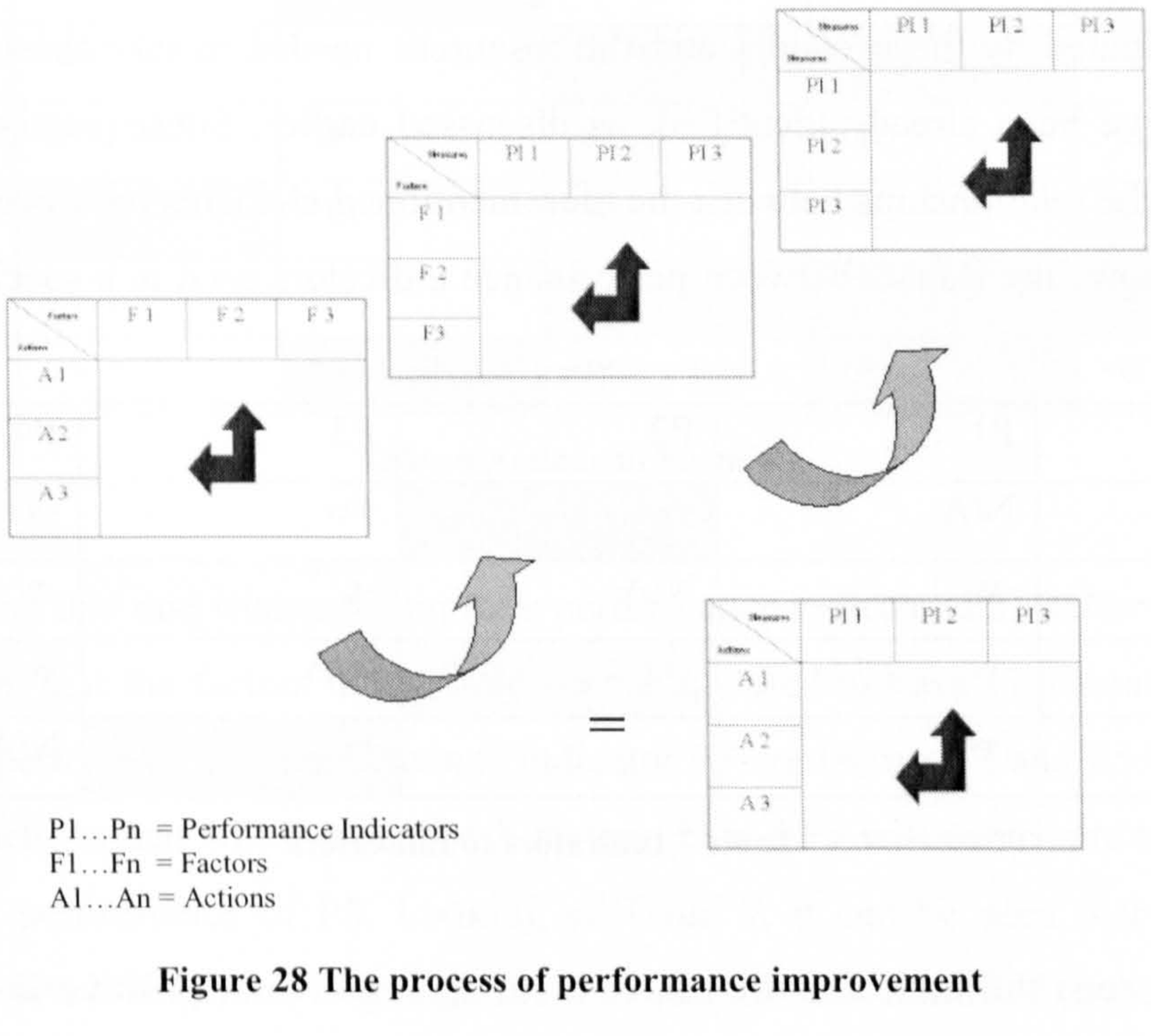


Figure 28 The process of performance improvement

6.2.4 Using the Performance Improvement Framework

The framework can be used in different ways depending on the application. The information contained within the framework after it has been populated can be used to:

- Assess the impact of one performance indicator on another one within the company's performance measurement system.
- Identify which factors should be manipulated in order to improve the performance of a performance indicator.
- Identify the actions that can be taken to alter that factor in line with business objectives and business circumstances.
- Assess the impact of these improvement actions on the overall performance measurement system and overall business strategy.

To illustrate the concept, let us assume that after the population of the framework we have the following tables. It is assumed that the performance data collection and the factor and action data analysis stages of the implementation are completed. That implies that the business performance indicators, the factors that affect them, the actions that can be initiated by these factors and the resources needed to take these improvement actions have been already identified, as discussed earlier. Subsequently, the matrices depicting the relationships between the aforementioned elements have been constructed. Table 7 shows the impact between performance indicators used in a specific part of the business.

	P1	P2	P3	P4
P1	N/A	+s	+w	-s
P2	-w	N/A	-s	-w
P3	-w	-s	N/A	-s
P4	+m		+s	N/A

Table 7 Indicators to Indicators

As can be seen the indicators that have a strong negative or positive impact on other indicators have been highlighted in this case to assist in the illustration of the example. Where there is no impact the fields have been left blank. The entry marked as N/A (Not applicable) is used to denote the relationship of an indicator to itself. Table 8 shows the corresponding table constructed to show the relationship between factors that may affect these indicators.

	P1	P2	P3	P4
F1	+s	-w	-m	+s
F2	-w	+m	+s	+s
F3	+w	+s	+m	
F4	+m	+w	-w	-s
F5		+s	+s	+w

Table 8 Factors to Indicators

Similarly, based on the collected information, Table 9 is constructed showing the impact of actions to the identified factors affecting performance.

	F1	F2	F3	F4	F5
A1		+s		-w	
A2	+m	+w	+s	+s	-w
A3	-w	-w	-s	+w	+m
A4	+s	+m	-w	-w	-s
A5	+w	+w	-s	+s	+s
A6		+s	-w	+s	-w

Table 9 Actions to Factors

Now assuming that one wishes to improve performance indicator P3. Referring to Table 7, it is shown that the factors that should be manipulated to have maximum impact on the level of performance of performance indicator P3 are factors F2 and F5. This means that taking actions that will increase both factors F2 and F5 will contribute to increasing the level of performance of P3. Looking at Table 9, it can be seen that in order to increase the level of F2 or F5 actions A1, A5 and A6 are identified as having strong positive impact on these factors, so these are the candidate improvement actions. Based on the factor and action analysis stage of the population it has been identified that actions A1 and A5 will incur more cost to undertake than action A6. Assuming cost is one of the limiting factors in these circumstances action A6 is selected as the appropriate performance improvement action to increase the level of performance of performance indicator P3. To this end, referring back to Table7, one can see that

improving P3 will also have a strong negative impact on indicators P2 and P4. In this example it is clearly demonstrated how the framework can:

- Identify potential improvement actions and
- Further highlight potential trade-offs inherent in these actions.

The above example is a simplified version of the use of the framework. It should be noted that the major objective of the framework is not to pinpoint specific performance improvement actions accurately but to highlight potential trade-offs when making decisions, and to illustrate the impact that improvement actions have on different areas of the business.

6.3 Advantages in Using the Framework

The previous example illustrated the use of the framework achieved through a series of steps involving data collection and the population of the framework through the use of relationship matrices. The framework can be used for different purposes:

- **Improvement of a specific performance indicator.** The framework can be used to improve a performance indicator by identifying the factors that affect that indicator and assessing their impact on it. The framework also identifies the potential impact these factors might have on other performance indicators within the company's performance measurement system. This mechanism enables the framework to identify performance improvement that is aligned with the business strategy.

- **Identifying factors to be manipulated.** The framework allows the indication of which factors should be manipulated to achieve the desired improvement on the level of performance of a specific indicator. This is done by assessing the impact of individual factors on specific performance indicators. The framework will indicate which factors will have the strongest impact on the performance indicator to be improved. Depending on the feasibility of manipulating that factor, the appropriate decision can be made. Moreover, by highlighting the

impact of a factor on other measures of performance the framework can indicate possible trade-offs that can be considered when making decisions.

- **Identifying improvement actions.** The framework will assist in identifying potential performance improvement actions that are in line with the business strategy and the business circumstances. By highlighting which actions will have the strongest impact on the factors that are to be manipulated, the framework contributes to indicating to the decision makers potential decision paths. Moreover, by considering the resources that each action requires, and the authorisation needed to undertake them, further optimisation in the decision-making can be achieved. Again, the impact on these actions on other areas of performance is considered to maintain the overall strategic alignment of the framework.

As it was mentioned earlier, one of the main objectives of the framework is to encourage the consideration of the potential trade-offs throughout the process of performance improvement. Furthermore, linking factors of performance that have been identified at lower levels to the overall business strategy, can contribute to the delegation of responsibility when taking those improvement actions. Consequently, this can lead to increased responsiveness and flexibility within an organisation. Moreover, considering the impact these actions have on other areas of performance can contribute to enhanced strategic alignment of the performance improvement process.

6.4 Validation with Industrial User

To ensure the practical validity of the framework and its usability it was decided to initiate its implementation to a part of the business of one of the TQM-Tile project partner companies. The implementation acted as a pilot study, since the complexity of the complete implementation was one of the issues that was recognised in the early stages of the research. The pilot study acted as the launching ground for the company to initiate a larger scale implementation. (Yin, 1994), states that a pilot study can help in the refinement of data collection plans with respect to both the content of the data and the collecting procedures.

As was mentioned in Chapter 5, both TQM-Tile companies had adopted a process approach to their management function. That meant that the implementation of the framework could be carried out in an environment within the boundaries of a major process of the business. That also meant that a lot of the information needed, such as process owners and performance data, would be readily available.

6.5.1 Validation Environment

The process maps of the companies are given in Appendix III. Company A was the most appropriate candidate for the pilot implementation of the framework since more performance data was available. The implementation of the framework was carried out over a period of one week involving interviews with relevant managers and personnel as well as more senior management. None of the managers involved in the development of the framework tool place in this process with the exception of the production manager who would oversee the process. The process on which the framework would be applied, was what the company called the Integral Logistics Process. This is one of the fundamental processes of the company. The company had adopted a system of classifying their processes based on their purpose. The types of processes identified were:

- **Strategic Processes** – i.e. Total Quality, Strategy Formulation, Performance Measurement.
- **Fundamental Processes** – i.e. Product Design, After Sales Service.
- **Support Processes** – Information Systems, Quality Control, Personnel Selection.

The criteria on which the processes were classified are given in Appendix III. It should be mentioned at this stage that this classification was only relevant to the companies involved and should not be considered a definite classification guide. Other companies might choose to classify their processes by using other designations such as management, operational etc.(APQC, 1996).

The Integral Logistics Process was a process incorporating several sub-processes within the organisation from a wide variety of areas. Each sub-process was characterised by

some objectives that were significant to the company's strategy realisation. Figure 29 illustrates the layout of the Integral Logistics Process.

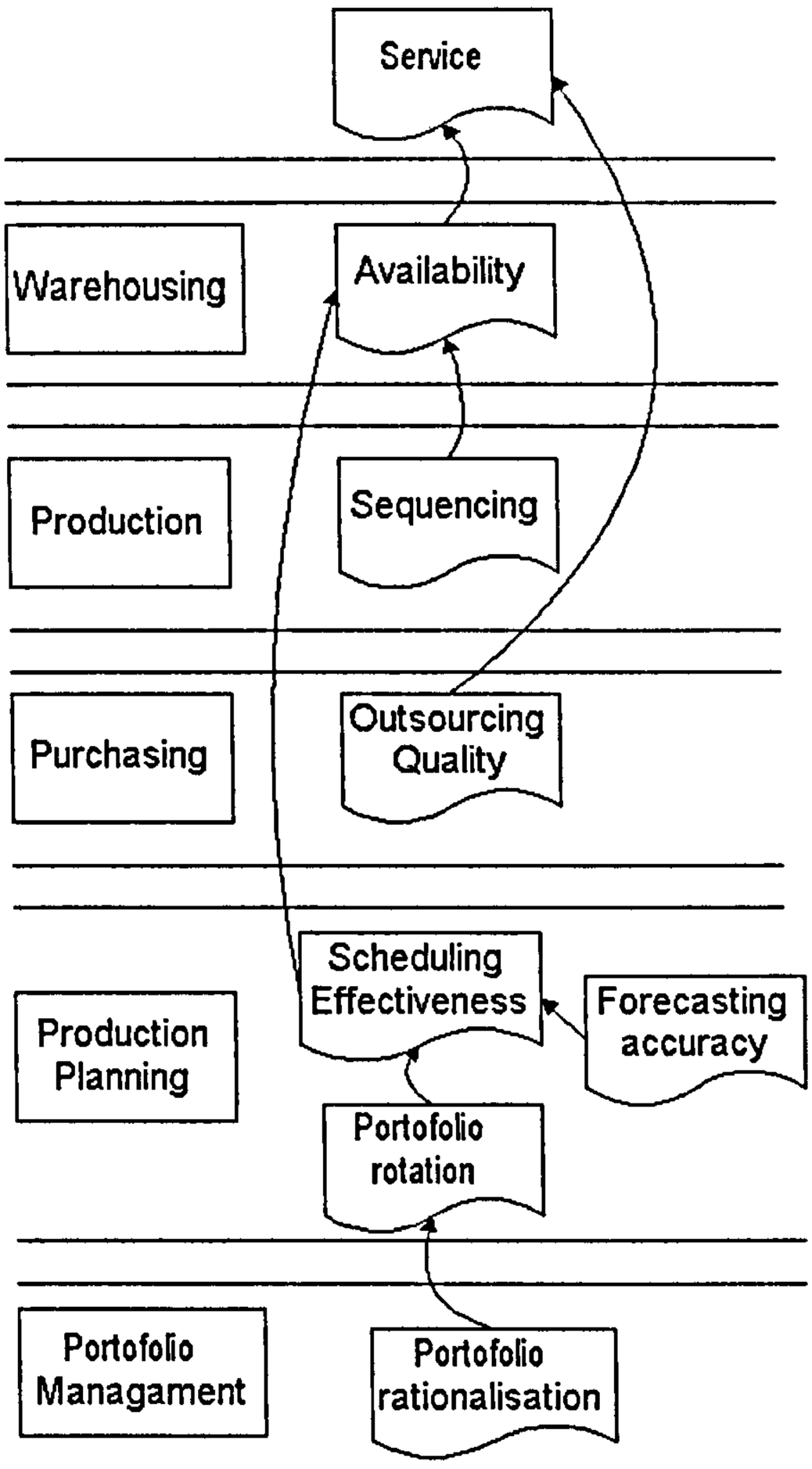


Figure 29 The Integral Logistics process

As Figure 29 illustrates, the sub-processes include a set of interrelated objectives from which the company had derived a set of operational indicators. The Integral Logistics Process was selected because it includes areas of the business that span production, warehousing and end service, hence providing a wider picture of the organisation. Moreover, this ensures that strategic objectives from these areas are represented at this level. The company's performance indicators were designed using the PMS design methodology developed within the TQM-Tile project, and the individual characteristics for each indicator were collected and developed using the form that is shown in Appendix II. The list of the operational indicators for this process used in the company

is shown in Table 10. The table also illustrates the sub-process each indicator was used in as well as a short explanation of its purpose.

Indicator	Description	Sub-process
Available Stock Time	This refers to the company's ability to meet demand without any further production of products.	Production Planning
First Quality Cost	This is the cost of products which meet customer specification (A - class quality) as a proportion of overall production costs.	Production
% First Quality Production	This refers to the percentage of products produced at the highest quality.	Production
Losses of Materials	This refers to raw material turnover i.e. percentage of raw material actually turned to finished product.	Production
Warehouse Stock Reliability	This refers to the number of mistakes in customer orders as a proportion of the overall number of orders received.	Production Planning
Product Reservation Management	The number of products that are kept in stock for more than three months	Warehousing
Economical Stock	The quantity of product that are produced an eventually sold on as sub-standard (B & C - class quality)	Warehousing
Customer Service	Number of orders planned and released in a week as a percentage of the total orders received	Service
Useful Available Stock	The overall quantity of first quality products in stock	Warehousing

Table 10 Integral Logistics process indicators

This represents a small portion of the indicators used throughout the company, the full set of the performance indicators used in Company A can be found in Appendix VI. The set is provided so as to appreciate the overall width of the company's performance measurement system and get an indication of its strategic direction.

6.5.2 Validation Process

The implementation of the framework consisted of interviews with the personnel involved in the Integral Logistics Process. This included the Logistics Manager, the Production Manager, the Warehouse Manager, as well as a number of middle managers

that were involved in the process. The inclusion of these managers was crucial, since commitment was a very important issue due to the complex nature of the task.

The process of implementing the framework was not seen as a one off exercise. The pilot was to be the start of an iterative process that would ultimately become an integral part of the Continuous Improvement/Total Quality Management function within the organisation. Time and resource constraints were acknowledged in the beginning and it was understood that the timescale for implementing the framework could potentially outlast the time of the pilot study.

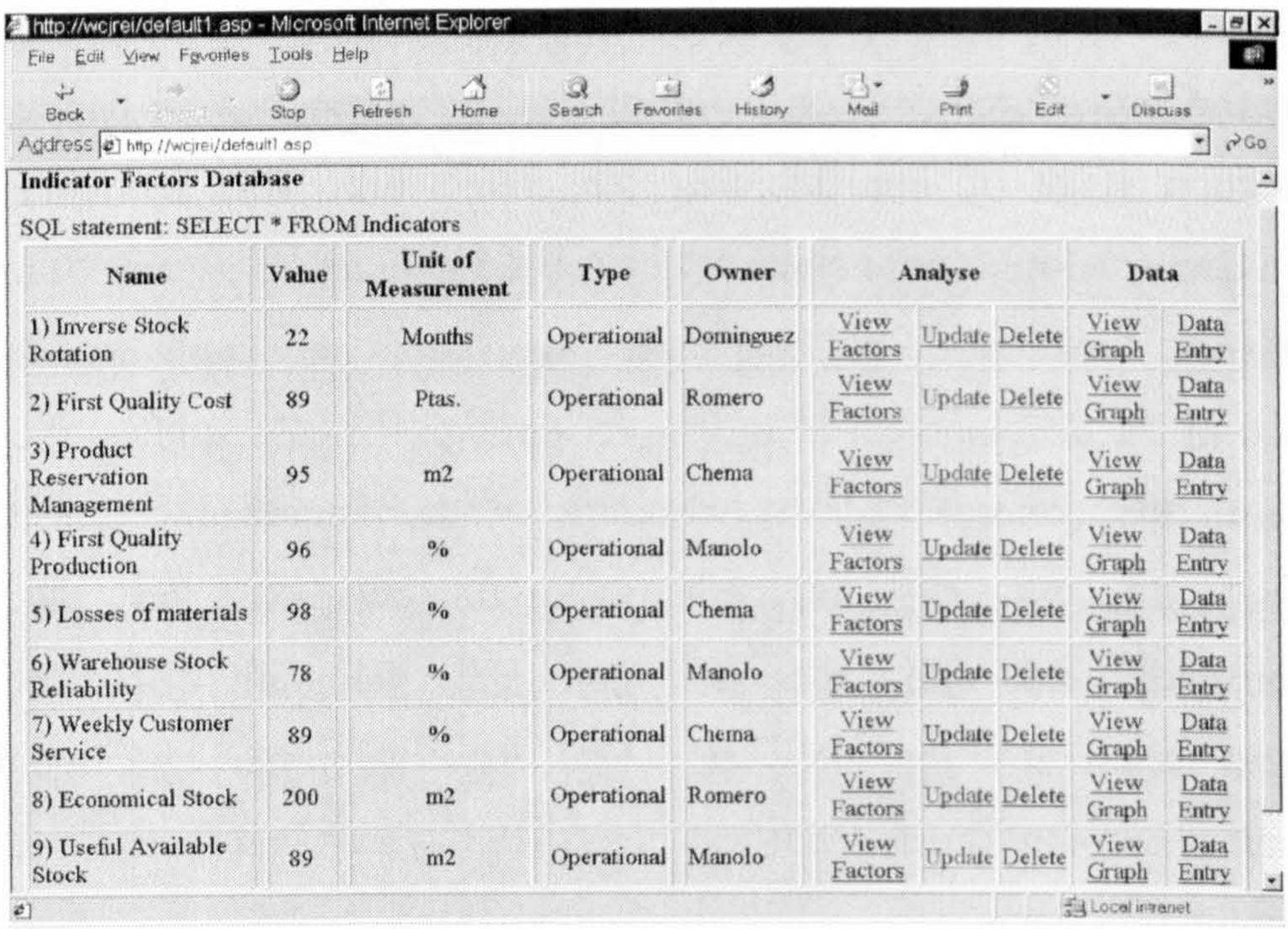
The tools and procedures developed throughout the research were applied during the data collection stage of implementing the framework. This particular stage also provided a deeper insight into issues closely related to practical aspects of implementing the framework. Since a lot of the people involved in the implementation had also participated in the development of the model through the case studies, they were quite familiar with the concept and the workings of the framework. Consequently, the rationale behind the process of implementing the framework was that 'educating' a few senior managers would allow them to continue the integration onto the company's management system after the one week period. As a result, having active management support and 'champion' the concept was considered as a crucial factor to the success of the implementation stage.

6.5.2.1 Performance Data Collection

The first stage of the implementation involved the performance data collection from the company's information system regarding the Integral Logistics Process. This was done in cooperation with the Logistics Manager to ensure that all procedures were clearly understood and also to facilitate any potential observations regarding the methods used that could not have been performed under different circumstances. Using the tools provided by the framework and through a series of interviews where the researcher was initially present, the management teams managed to collect a significant amount of information regarding the factors that affect the nine performance indicators within the Integral Logistics Process. At this stage, it was observed that the design of the company's performance measurement system facilitated considerably the extraction of

the relevant information. The managers were quite effective in identifying factors that affect performance and also factors that are important but out of their control.

To facilitate the data collection and to simplify the task a set of online web-based intranet tools was developed based on Active Server Page (ASP) technology. The reason behind the development of online tools was that this would enable the gradual population of the framework online, even after the researcher had left the company. Figure 30 illustrates a snapshot of the performance indicator collection tool.


http://wcjrei/default1.asp - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Stop Refresh Home Search Favorites History Mail Print Edit Discuss

Address http://wcjrei/default1.asp Go

Indicator Factors Database

SQL statement: SELECT * FROM Indicators

Name	Value	Unit of Measurement	Type	Owner	Analyse			Data	
1) Inverse Stock Rotation	22	Months	Operational	Dominguez	View Factors	Update	Delete	View Graph	Data Entry
2) First Quality Cost	89	Ptas.	Operational	Romero	View Factors	Update	Delete	View Graph	Data Entry
3) Product Reservation Management	95	m2	Operational	Chema	View Factors	Update	Delete	View Graph	Data Entry
4) First Quality Production	96	%	Operational	Manolo	View Factors	Update	Delete	View Graph	Data Entry
5) Losses of materials	98	%	Operational	Chema	View Factors	Update	Delete	View Graph	Data Entry
6) Warehouse Stock Reliability	78	%	Operational	Manolo	View Factors	Update	Delete	View Graph	Data Entry
7) Weekly Customer Service	89	%	Operational	Chema	View Factors	Update	Delete	View Graph	Data Entry
8) Economical Stock	200	m2	Operational	Romero	View Factors	Update	Delete	View Graph	Data Entry
9) Useful Available Stock	89	m2	Operational	Manolo	View Factors	Update	Delete	View Graph	Data Entry

Local intranet

Figure 30 PI data collection tool

6.5.2.2 Factor and Action Analysis

The next stage involved identifying the possible improvement actions each of the affecting factors could initiate. The managers were again quite effective in identifying potential improvement actions, and this was probably due to their experience and knowledge of the specific processes, a variable that is manipulated by the framework. This experience and knowledge was also used when identifying the resources needed for each action. During the latter stage, it was interesting to see that managers were quite keen to 'quantify' their knowledge about processes and performance improvement actions and felt that would be of benefit to individual performance improvement initiatives undertaken within the company.

6.5.2.3 Relationship Matrices

After the data collection stages, the creation of the relationship matrices was initiated. This was performed in an environment where initially, the participation of as many people as possible was sought. This was done to ensure that the relationships identified and their impact were confirmed and validated by as many people as possible. Moreover, in the case of any disagreement there would be opportunity to discuss the disputed relationship until a consensus was reached.

Another online tool was developed to facilitate the data collection, and also improve the presentation of the matrices. Figure 31 illustrates one of the resulting matrices.

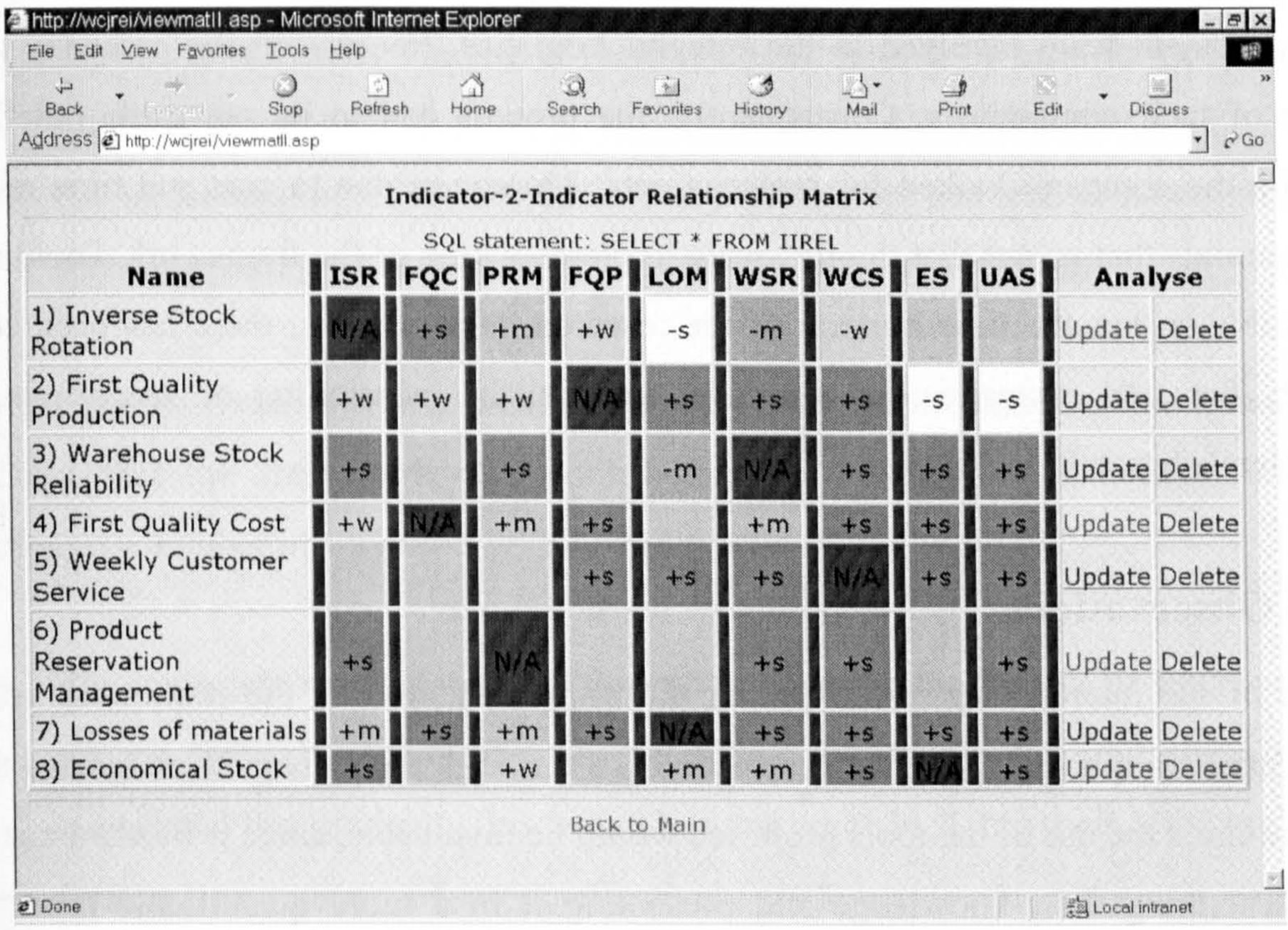


Figure 31 Indicator to Indicator matrix

6.5.2.4 Pilot Implementation Progress

After the completion of the framework population stages the company was left to continue the iterative population and enrichment of the framework and ultimately start initiating performance improvement actions based on it and in-line with the strategy. The researcher, through the use of the online tools and frequent communication, kept in touch with the progress of the process, to ensure that any questions could be answered in a timely fashion.

There was positive feedback received from the company in the first few weeks of the implementation. The company acknowledged the benefits derived from using the framework, but unfortunately during the end of the research the majority of the management team involved in the Integral Logistics Process left the company to join one of their competitors. Consequently, the process had to be put aside indefinitely while the company looked for replacements. Moreover, due to cost and time resource constraints that meant that the full-scale implementation of the framework would not be possible within the time horizon of the research. Nevertheless, there has been contact with the new management team to explore the possibility of undertaking the implementation in the future.

6.6 Observations

One of the main issues raised during the implementation of the framework was the potential complexity of the data collection. To this end, the managers recognised that in some cases the use of the tools proposed would be invaluable, since it would assist them in structuring their knowledge and presenting it in a more quantifiable form. They viewed this as a potentially important tool in their decision-making not only for improved optimisation and strategy alignment reasons but also for communicating that strategy to lower levels in a more structured way.

The interviews held during the data collection and matrix creation stages were very helpful in that they contributed to achieving general consensus regarding the relationships within the company's performance measurement system. In cases where the strength of the relationship was in dispute, the managers would reach a compromise agreed by all parties. This meant that there was overall understanding regarding

improvement actions within the company and the framework was applicable and valid in that respect.

Some of the most important conclusions during this stage that are very important to the research were:

- It is possible to collect information regarding factors that affect performance, performance measures and improvement actions from a 'well' designed performance measurement system.
- It is possible to define relationships between these elements using tools and techniques present in the company's performance measurement system.
- The structured understanding of these relationships can be used for performance improvement.
- The understanding of factors that affect performance can lead to more informed decision-making when taking performance improvement actions.

The feedback provided by the company following the implementation of the framework indicated that the framework was contributing to the company's decision-making function in a number of ways:

- The managers were indirectly 'forced' to consider the impact of improvement actions throughout the business by using the framework and thus it was anticipated that gradually this would become embedded into their 'thinking'.
- Strategy was conveyed more effectively to lower levels making it easier to understand the strategic relevant of actions and factors of performance.
- Improvement actions were considerably more aligned to the business strategy and were better optimised for the use of appropriate resources.
- The managers indicated that the layout of the matrices helped them understand better the various factors that affect performance and thus provide them with a wider picture of the improvement potential of the business.
- The better understanding of the strategic relevance throughout the organisation resulted in the company initiating a plan for delegating improvement

responsibilities throughout the performance measurement system. That was performed in line with the company's strategic objective of increased flexibility and increased responsiveness regarding performance improvement and also better usage of resources and time.

- The company reported that the framework assisted them in identifying potential sub-optimisation areas or improvement actions conflicting with the business strategy before these actions were taken. Indeed, the company had adopted the framework as an 'early-warning' tool regarding potential areas of sub-optimisation.

Elaborating on the concept, the implementation of the framework demonstrated its applicability in an environment defined by the application boundary set out earlier in this chapter.

6.7 Summary

This chapter presented the way the framework can be used to facilitate performance improvement. It also discussed the implementation of the framework in a real environment. The different stages involved in the population and use of the framework were demonstrated, as well as the creation of interrelationship matrices that assist in the decision-making function of the business.

The framework was validated as a pilot study in one of the partner companies through the use of interviews and data collection tools specifically designed for this purpose. The pilot study was planned to be developed into a larger scale implementation of the framework. The results from the validation process demonstrated that the framework can be of benefit to a company's decision-making function, and can contribute to better strategic alignment of improvement actions.

Furthermore, the framework confirmed the research assumptions regarding the availability of information and the relevant information needs needed to populate the framework within the environment of a 'well' defined performance measurement system.

Chapter 7 – Discussion

7.1 Introduction

The research presented in this thesis examines performance improvement in alignment with business strategy and current business circumstances within the field of performance measurement. A framework has been developed to allow the formal integration of causal links in the process of performance improvement. Furthermore, it has been demonstrated how the proposed framework can provide an input to the decision making function of the organisation relating to proactive performance improvement. The proposed research relates to a considerable gap in the literature and to a subject that is emerging as one of the key areas of research in the field of performance measurement. The research hypothesis is investigated through the development and validation of such a framework, using a combination of case studies and analytical work throughout the course of the research. The research is presented in detail in Chapters 4,5 and 6 and is based on the conceptual framework and research methodology outlined in Chapter 3. This chapter brings together all the parts of the research presented and discussed in the previous chapters. It also analyses the findings and the research achievements, as well as discussing the methodology employed to carry out the research.

7.2 Literature Findings

There has been an increasing volume of literature in the field of performance measurement. As it was discussed in Chapter 2, the late 1980's and early 1990's saw the emergence of a wave of radical rethinking in the field. This rethinking was triggered by the recognition of the limitations of traditional financially based measures and measurement systems that were inadequate in conveying the new strategies that were required in the modern markets. Their shortcomings have been documented extensively and have been the subject of a lot of research (Banks and Wheelwright, 1979; Kaplan, 1984b; Globerson, 1985; Kaplan, 1986; Johnson and Kaplan, 1987; Andersson et al., 1989; Dixon et al., 1990; Eccles, 1991; Kaydos, 1991; Zairi, 1992; Zairi, 1994; Fitzgerald, 1996; Ghalayini and Noble, 1996).

This led to the development of new performance measurement system design methodologies such as the Cambridge process (Neely, 1996) and the Integrated Performance Measurement System approach (Bititci et al., 1997), amongst others. These approaches aimed at comprehensively building performance measurement systems that systematically addressed the weaknesses of traditional financial measures. Furthermore, they encompassed a large number of documented guidelines on how to build a 'good' performance measure. These guidelines and recommendations have been reported by a large number of authors (Fortuin, 1988; Andersson et al., 1989; Keegan et al., 1989; McNair, 1990; Azzone et al., 1991; Kaydos, 1991; Maskell, 1991; Kaplan and Norton, 1992), amongst others. Within this context despite strategic relevance being one of the key themes that have emerged in the area of performance measure design, there is very little work that examines the strategic relevance of actions that can be taken to improve a measure.

Within the area of performance improvement, the research presented the existing debate on whether trade-offs exist within the function of decision-making based on a company's competitive priorities. The research also examined and reviewed the importance of establishing such priorities in performance improvement. Despite the volume of literature supporting that trade-offs need not exist within an organisation, there is little evidence in literature to support that organisations have managed to achieve this in practice (New, 1992).

(Neely and Wilson, 1992), argue that to overcome the problem of trade-offs there is a need to establish a long term strategy complemented by effective goal congruence throughout the organisation. Despite this position, implying effective deployment of strategic objectives throughout an organisation, the majority of the considerations regarding trade-offs has been considered at the higher levels of an organisation. There has been very little work regarding the consideration of trade-offs at a more detailed operational level. Consequently, the research fills a significant gap in the wider field of performance measurement, relating to the interaction of low-level improvement activities to the overall organisational performance by considering the company's competitive priorities.

The next step in the course of research within the field of performance measurement concentrated on the development of performance measurement frameworks, which aimed at presenting a more comprehensive and balanced view of business performance. These frameworks were a derivation of the weaknesses of traditional measures that by nature were uni-dimensional and backward looking (Kaplan and Norton, 1992). This in turn led to the development of innovative performance measurement system frameworks such as the Balanced Scorecard (Kaplan and Norton, 1992), and the results criteria of the EFQM Excellence Model (EFQM, 2000). Additional frameworks such as the performance measurement matrix (Keegan et al., 1989) and the SMART system (Cross and Lynch, 1988-1989), further supported the emerging need for frameworks that provided more than one perspective to describe business performance. The current research reviewed and compared a number of performance measurement frameworks which sought to present the performance of a business through the prism of comprehensiveness and balance. The research concluded that these frameworks aimed at addressing performance measurement by displaying characteristics such as:

- Balanced
- Comprehensive
- Multi-dimensional
- Accurate
- Integrated

Amongst others, there is a growing area of interest within performance measurement frameworks to include the measurement of drivers of performance. The research reviewed frameworks such as Brown's Macro Process Model, the Balanced Scorecard and the EFQM Excellence Model amongst others, that clearly demonstrated the inclusion of such a mechanism and its importance to the management of business performance. Either by means of implicit models of causal relationships (EFQM, 2000) relating factors of performance, or by more explicit means that have been documented (Kaplan, 1996a), there is growing interest in the area of research the current work is based on. This is further supported by the fact that frameworks such as the Balanced Scorecard, that incorporate a consideration of causal relationships within a performance

measurement system, have become so successful. Indeed, during the first quarter of 2000 all major Enterprise Resource Planning (ERP) suppliers released modules based on the Balanced Scorecard (Neely, 2000).

Despite such attempts, the research established that there is a significant gap in this area, in that a structured framework relating factors of performance to business performance does not exist. Moreover, despite the notion that performance measurement systems should promote vertical and horizontal integration (Bititci, 1995; Neely et al., 1995; Bititci et al., 1997; Bititci et al., 2000), a framework that can facilitate that, does not exist. To this end, the research also established that the majority of the work within performance measurement, either in the form of performance measurement frameworks or in the form of performance measurement system design methodologies, mainly focuses on the corporate and higher levels of an organisation. Indeed, the literature review does not suggest that there is enough evidence to support otherwise. Moreover, in the context of performance improvement within performance measurement there is a need to consider factors that affect performance and the impact of such improvement actions in different areas of performance (Dixon et al., 1991; Bititci and Swenson, 1993; Brown, 1994; Bititci, 1995; Kennerley et al., 1996). The need was further established by the evidence in literature that where factors of performance are not considered and the impact of an action is viewed in isolation, sub-optimisation might occur (Fry, 1989; Dixon et al., 1991; Kaplan and Norton, 1992; Bititci and Swenson, 1993; Brown, 1994; Bititci, 1995; Neely et al., 1995; Kennerley et al., 1996; Rigas and Fan, 2000).

The research reviewed performance improvement within performance measurement and its links to continuous improvement. The concept of performance measurement supporting continuous improvement has been supported by several authors (Azzone et al., 1991; Bititci, 1995; Neely et al., 1995; Ghalayini and Noble, 1996; Bititci et al., 1997; Neely et al., 1997; Bititci et al., 2000). The research illustrated the importance of continuous improvement as part of performance improvement and positioned the research concept within the field.

The research concluded that despite the trend set by the evolution of performance measurement frameworks towards considering factors of performance, and in conjunction with considerations relating to trade-offs, there is no structured framework or approach currently available to facilitate that. More specifically, within the context of performance improvement, no structured framework exists that takes into account business objectives, factors of performance, and improvement actions in alignment with the overall business strategy. The research fills an important gap in this area of performance measurement, by facilitating performance improvement incorporating all the above considerations combined with current business circumstances.

7.3 Research Achievements

The current research investigated performance improvement within the context of business performance measurement. The research also investigated the mechanism through which strategically aligned performance improvement can be achieved, namely through a framework incorporating cause and effect relationships between the elements of a performance measurement system. The research contributes to the area of performance improvement within performance measurement in a number of ways:

Strategic alignment

The proposed performance improvement framework links lower-level elements of a performance measurement system to its strategic levels. This results in achieving an explicit understanding of a measure of performance and how the actions taken to improve it could affect the overall strategy of the organisation. The concept of performance measures being aligned to the overall business strategy has been supported by a number of authors (Globerson, 1985; Maskell, 1989; Dixon et al., 1990; Wisner and Fawcett, 1991; Kaplan and Norton, 1992; Kaplan and Norton, 1993; Bititci, 1994). The research reflects the concept by providing an understanding of how business performance at low-levels will affect performance at higher and corporate levels. This is especially relevant bearing in mind that it is crucial to have an understanding of how corporate performance and customer satisfaction will be affected by low-level actions through a company's strategic objectives (Kaplan and Norton, 1996c). This fact was further demonstrated in the case studies where the majority of the managers supported

the concept underpinning the framework and its subsequent implementation. During the trial implementation, it was demonstrated how decisions can be made on a more informed basis as opposed to basing only on perception. The framework demonstrated how lower level improvement actions are linked to factors that in turn affect performance measures. This was demonstrated in Chapter 6, thus ensuring not only the strategic alignment of measures but also of improvement actions that can be initiated from these measures. Consequently, this ensures that the strategic relevance of all measures and actions is better understood. This explicit understanding of strategic relevance is very important, especially at the lower levels of the performance measurement system where strategic relevance might not be so obvious, a fact supported by the results of the case studies. The use of the framework demonstrates how this fact can increase the visibility and transparency of the performance measurement system and the organisational strategy, a concept supported by several authors (Hall, 1983; Lea, 1989; Crawford, 1990; House and Price, 1991).

Identifying factors to be altered

Chapter 6 demonstrated how the performance improvement framework could be used to identify the factors that should be altered to improve performance in alignment with the business strategy and the company's competitive priorities. It was illustrated how the framework can identify the appropriate factors to be manipulated to improve performance of a measure, considering the impact this will have on other areas of the business. This notion was strongly supported in literature (Beischel and Smith, 1991; Bititci, 1995; Brown, 1996; Kaplan and Norton, 1996b). The identified factors could be manipulated in a number of ways, allowing for the inclusion of industry or company specific practices to be included as defined by the organisation (Kennerley, 2000). The factors that affect performance in conjunction with the improvement actions that can be initiated by these factors to produce the desired change in performance from an integrated performance improvement mechanism within the framework, a notion supported by a number of authors (Globerson, 1985; Maskell, 1991; Kaplan, 1994).

Assessment of the effects of manipulating factors

The cause and effect mechanism inherent in the performance improvement framework enables the assessment of the effects of manipulating factors both on higher levels of performance (vertically) and other related measures (horizontally). This notion is supported by a number of authors (Neely et al., 1995; Flapper et al., 1996; Bititci et al., 1997), and allows the identification of improvement actions to achieve the desired improvement in performance. That in turn, if reversed, assists in identifying possible causes of poor performance, thus acting as a diagnostic tool as well. This mechanism enables the appropriate use of resources to achieve the maximum benefits possible. Furthermore, once a factor and the effect of manipulating it are identified, the impact of this manipulation on other measures and business objectives can be identified. This ability is supported by the concept that within a performance measurement system a change in one area also affects other areas of the business (Bititci, 1995; Kennerley et al., 1996; Rigas and Fan, 2000). One of the secondary benefits of such an approach is the more explicit understanding of the link between the quality of the planning and the outcome of the execution of the plans (Kennerley, 2000).

Identifying potential improvement actions

The framework allows for the identification of performance improvement actions that can be initiated by each of the identified factors. This is done through two separate perspectives within the performance measurement system. Firstly, the improvement actions are assessed based on their effect on the factors and other elements of the performance measurement system. This allows for ensuring the strategic alignment of low-level actions as supported by a number of authors (Bititci, 1995; Kennerley et al., 1996; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c; Bititci et al., 1997; Bourne, 1998). Consequently, actions with the maximum effect on the identified factor can be indicated. Again, the framework allows for the inclusion of improvement actions that are company or industry specific as mentioned earlier in this chapter. The assessment of the impact of low-level improvement actions was one of the main themes that emerged during the case studies. To this end, a number of managers acknowledged the enhanced ability to assess the strategic impact of lower level actions within the organisation.

Secondly, the framework examines the improvement actions based on the resources available within the organisation. This ensures the realistic feasibility of the improvement actions and also that there are no potential resource conflicts that could affect the realisation of the overall business strategy. It also allows for the better planning of those resources during the decision making process, thus enhancing the optimisation capability of the company.

These two facets of improvement actions allow for these considerations to be included in the decision making process and be a part of potential trade-offs depending on the company's priorities.

Considering trade-offs

It was discussed in Section 2.3.4 how trade-offs have been considered in literature and the debate evident in literature regarding their existence. The research demonstrated that trade-offs between dimensions of performance do exist. Subsequently, the research also demonstrated that the better understanding of the factors that affect performance and their implications on the business can contribute to the effective management of these trade-offs (New, 1992). The existence of these trade-offs implies the possibility of sub-optimisation (Fry, 1989; Neely et al., 1995). The proposed performance improvement framework allows the identification of such trade-offs and their effective management or potential elimination when taking decisions. This is done through the use of the cause and effect model within the framework that ensures that performance dimensions are related the organisation and the customer at all levels. The understanding of the explicit impact of improvement actions throughout the organisation on all areas of performance is a key benefit of the framework in this context. The framework clearly demonstrates the concept of such trade-offs by highlighting for example, measures that have a positive effect on one area of the business but a negative effect on another. This allows for these considerations to be incorporated in the decision making process at an earlier stage, thus reducing the corrective efforts within the performance measurement system.

Understanding the wider impact

The framework is not limited to assessing the impact of factors and actions to only one part of the organisation. The framework allows the consideration of improvement actions throughout the organisation thus overcoming organisational barriers that might exist. That allows for a better understanding of the impact of actions on other processes, functions or business areas. To this end, the research contributes to overcoming limitations such as 'functional silos' within organisations, which can act as communication barriers thus inhibiting cross-functional co-operation (Hall et al., 1990). The framework also allows for the consideration of a combination of improvement actions towards the improvement of business performance thus taking into account different areas of the business. This 'wider' perspective also contributes to reducing duplicating efforts that might take place if people are only limited to considering the impact on improvement actions within their area of responsibility (Fuller, 1997). The cross-functional nature of the framework further reduces the risk of sub-optimisation, since it provides the necessary information to ensure that all improvement actions are in line with organisational objectives rather than individual objectives. The framework also allows for the inclusion of factors that might be external to the business area or process, internal or external, that directly affect business performance, thus considering their implications. A further benefit of the framework in that area was demonstrated by the case studies as 'positive' change in the mindset of the managers that by the use of the framework were being 'forced' to include these cross-functional considerations in their thinking process.

Communication

The framework through explicitly presenting the strategic relevance of measures and improvement actions, facilitates the communication of strategic objectives throughout the organisation. To this end, it ensures that strategic objectives are clear and visible to all levels within the organisation, and that performance reflects these objectives (Hall, 1983; Lea, 1989; Crawford, 1990; House and Price, 1991). (Neely and Wilson, 1992) suggest that strategies should be consistent at all levels of the organisation to ensure a common direction of the efforts within the business. The use of the framework assists

people that are very knowledgeable of their own activities but are not very clear of their impact on other areas of the organisation (Stoop and Bertrand, 1997).

Flexibility and responsiveness

One of the potential benefits of using the framework is the effective delegation of responsibility and decision making to lower levels of the organisation. This is achieved by illustrating the strategic relevance of improvement actions and performance measures and factors at all levels of the organisation. Consequently, this can contribute to the better allocations and use of resources within the organisation leading to increased responsiveness and flexibility. (Dixon et al., 1990), support that this can increase the contribution of employees towards the organisation, and it is even suggested that this can lead to a reduction in cost and an increase in the effectiveness of decision making (Hall et al., 1990). (Kennerley, 2000), supports that enabling employees to take decisions at a lower level, can increase the speed of the decisions as well as the quality of the decision since they are closer to the area and have a better understanding of the circumstances. Moreover, providing employees with the needed information decisions in line with organisational strategy can be made more easily.

7.4 Research Development

The research reported within this thesis builds upon existing work in the area of performance improvement within performance measurement. The research supports Burbridge's proposition that: "..providing one does not attempt to specify quantitative relationships in quantitative terms, it is possible to make statements about system variable connectance, even though they may not be relevant in all production systems" (Burbridge, 1984a). The framework proposed in this thesis does indeed include such relationships between factors of performance. The research also expands on Kennerley's proposition that, it could be possible to apply a framework of cause and effect relationships to areas other than production systems (Kennerley, 2000). The research concludes that, it is possible to develop a performance improvement framework consisting of information regarding business objectives, performance measures, factors of performance and improvement actions, linking them to higher level

objectives to facilitate performance improvement. The research is consistent with the initial hypotheses stated in Chapter 2.

The basis for the research was illustrated through a conceptual framework discussed in Chapter 3. The framework illustrates the way in which higher level business objectives are linked, to performance measures and factors of performance as well as potential improvement actions. Chapter 2 established that higher level business objectives could be defined in different terms as a function of Time, Cost, Quality and Delivery. The measures of performance are derived from strategic objectives following 'good' performance measurement system design guidelines in an attempt to ensure strategic alignment between objectives and measures. The conceptual framework was populated and further developed by means of case studies and developmental work undertaken throughout the research.

The field of performance measurement that this research is part of, supports the notion that organisations can benefit from implementing performance measurement (Andersson et al., 1989; Neely et al., 1995). Indeed, several authors have produced empirical evidence that organisations using performance measures perform better than those who do not (Lingle, 1996; Fawcett and Cooper, 1997). Consequently, and in agreement with the literature findings, it is assumed that the use of performance measures should actively support improvement (Globerson, 1985; Lynch and Cross, 1991; Maskell, 1991; Bititci, 1995). By ensuring the strategic alignment of measures, factors of performance and actions, the performance improvement framework also supports the strategic alignment of improvement.

As was discussed in Chapter 2, the debate over the existence of trade-offs is an issue that has occupied a large part of literature relating to strategy. This issue is particularly relevant in the context of performance improvement this research is positioned within. Traditional supporters of the concept support the existence of trade-offs (Skinner, 1969), whereas later literature especially in the area of World Class Manufacturing support that they do not exist (Schonberger, 1986). The current research agrees with the latter view that trade-offs do exist and are present as considerations in the decision

making function of organisations. However, it is also concluded that this statement on its own has no real value, thus the need to mange these trade-offs is pertinent within the context of the research.

The framework further supports the consideration of resources within performance improvement undertaken in a performance measurement system. Despite this very concept –of optimisation- being widespread in the field of operations management, this is not the case in the field of performance measurement (Fan and Rigas, 1999). Consequently, the framework contributes to further aligning performance improvement actions to the overall strategy of the business, by ensuring that the resources needed are not in conflict with higher level business objectives. To this end, the research supports a number of improvement initiatives that are used within organisations, in that it can be used to assess the impact of actions undertaken within those initiatives and within the strategic relevance of performance measurement.

7.4.1 Analytical Comparisons

Within the field of performance improvement within performance measurement, a number of authors have identified the need for a framework of cause and effect relationships within an organisation, to better understand performance (Beischel and Smith, 1991; Feurer and Chaharbaghi, 1995; Kaplan, 1996a; Kaplan and Norton, 1996b; Kaplan and Norton, 1996c). However, there have been limited instances in literature where cause and effect relationships have been materialised, and most of the work has been carried out at the strategic level. The following section will review the literature instances where the research concept has been examined and compare then to the research.

Production System Variable Connectance Model

As reported in Chapter 2, one of the few instances where variables affecting performance have been considered, is J. Burbridge's work on the Production System Variable Connectance Model (Burbridge, 1984a; Burbridge, 1984b). Burbridge's model is a model consisting of qualitative relationships between approximately 200 production variables that affect performance within production systems. It only concentrates on

production systems and does not take into account balanced performance measurement, concentrating on cost rather than strategic objectives. Moreover, it does not consider explicitly performance improvement and improvement actions. This reflects the age of Burbridge's work which does not reflect the recent changes in the field and focus of performance measurement. However, the Production Variable Connectance Model was the first generic model to consider cause and effect relationships and was developed to assist managers in managing production systems.

Kennerley's model of Manufacturing Planning and Control (MPC)

Kennerley's work within Manufacturing Planning and Control Systems (Kennerley et al., 1996; Kennerley et al., 1996; Kennerley, 2000) was a significant step in developing Burbridge's concept further by considering strategic objectives, to reflect recent changes in performance measurement. Kennerley's model was specifically developed for MPC systems, and consisted of a predetermined set of performance indicators that were sourced from literature and empirical work. Consequently, the work sought to be generic in that context. The model did link performance measures and factors of performance within the MPC system, and did so by ensuring the balanced nature of the measures, i.e. the measures used were derived from the strategic objectives of Quality, Cost, Time and Delivery, Reliability & Flexibility and were a mixture of financial and non-financial, thus overcoming the limitations of Burbridge's model.

Kennerley's work, although trying to be generic, does not reflect the dynamic nature of performance measurement that states that performance measurement is a dynamic quantity that changes (Wisner and Fawcett, 1991; Bititci, 1995; Bititci and Carrie, 1998). As a result, the predefined set of performance indicators and relationships cannot easily accommodate changes in the performance measurement system. Another criticism of the framework is the relatively contradicting nature of part of its relationships. Although great effort has gone into ensuring that performance measures are derived from strategy during the design stages, the framework allows for the consideration at a later stage of relationships between measures and objectives, thus creating a potentially conflicting environment. This is possibly due to the framework not being developed as an integral part of the company's performance measurement

system and instead being a separate entity. Kennerley's model demonstrated the importance of understanding the 'wider' picture of performance and its causes within MPC system, but nevertheless, in a similar manner to Burbridge's work, the overall aim was to assist managers in managing the MPC system. There is no explicit consideration of performance improvement, since the model sought to assist managers in making decisions within MPC system by having more information. The model did not initially consider explicitly improvement actions as such, although later work concentrated on establishing 'best' practices that should be implemented to achieve performance improvement. Consequently, there was no consideration of the resources needed to undertake performance improvement actions.

Summarising, Kenerley's work has been an important step in the development and inclusion of cause and effect relationships within the wider field of performance measurement. It was the first attempt towards this direction within the area of modern performance measurement, and despite its drawbacks established a better understanding of the role of causality within performance measurement systems. The author believes that Kennerley's work and the performance improvement framework proposed in this thesis share common characteristics. However, the proposed performance improvement framework is more comprehensive and complete in its understanding of causality. Similar to Burbridge's work, Kennerley's work cannot be applied in a modern dynamic performance measurement system, since both models contain pre-determined measures, a notion explicitly opposed in modern literature, by the belief that measures should differ from company to company (Maskell, 1991).

Quantitative Model for Performance Measurement Systems (QMPMS)

Another model found in literature utilising the Analytical Hierarchy Process within performance measurement is the Quantitative Model for Performance Measurement Systems (Suwignjo et al., 1997; Suwignjo et al., 2000). The Analytical Hierarchy Process (AHP) (Saaty, 1980) is a multi-attribute decision making methodology, which by using pair wise comparisons seeks to establish the best course of actions amongst several alternatives. The technique develops a hierarchical structure of the decision problem, however, it is quite complicated and does suffer from the phenomenon of 'rank

reversal' where the model is unable to deal with added or removed decision alternatives (factors). The QMPMS is a very effective methodology in converting subjective judgement on which it is based on such as cognitive maps and tree diagrams into a quantifiable decision problem. In the specific context, the weight of each factor affecting a performance measure can be established. Consequently, and based on the notion that a change in a factor will result in a change on the performance measure, the impact of that change can be quantified.

The QMPMS is based on subjective judgement hence, the quantifying mechanism underpinning it is prone to errors. Furthermore, the QMPMS does not consider performance measurement through a balanced and strategically aligned perspective, but instead is applied on existing hierarchical structures, without examining the quality of their design. Moreover, this is done in the light of understanding performance rather than performance improvement. There is no consideration of improvement actions, or of the resources needed to undertake them, and consequently the QMPMS examines performance measurement from a limited perspective. However, the QMPMS has proved a very effective methodology for identifying potential factors of performance that can be altered to improve a measure albeit ignoring whether these are in alignment with the overall business strategy. The author believes that the QMPMS could complement the current research by potentially applying the 'quantifiable' element to the performance improvement framework.

The following table illustrates the different models and summarises how they compare within the context of performance improvement and performance measurement.

Model Attributes - Considerations	Performance Improvement Framework	Kennerley's MPC Model	Burbridge's Production Variable Connectance Model	Suwignjo's QMPMS
Strategic Alignment	Yes	Yes	No	No
Application	PMS	MPC	Production	PMS
Decision-Making	Yes	Yes	Yes	Yes
Performance	Yes	Yes - implicit	No	No

Improvement				
Improvement actions	Yes	No	No	No
Resources	Yes	No	No	No
Balanced	N/A (Relies upon existing PMS)	Yes	No	No
Expanadble	Yes – in accordance with the company's PMS	No	No	No
Trade-offs	Yes	Yes	No	No
Relationships	Qualitative	Qualitative	Qualitative	Quantitative

Table 11 Model comparison

As can be seen in Table 11, the performance improvement framework reported in this thesis builds upon existing work in the area of performance improvement within performance measurement, and in many areas complements existing approaches. Finally, one major difference the proposed improvement framework has over other approaches is that it is designed to utilise the information found in a company's performance measurement system, which also forms one of the requirements for its practical application. Although, this may sound like a limitation, since the quality of the framework's implementation will, heavily depend on the quality of the PMS's design, this also implies that it overcomes limitations associated with the ease of application in the other approaches.

7.5 Research Methodology

The research reported in this thesis was undertaken in different steps corresponding to its development stages:

- Initial theory development.
- Detailed development of the framework and case studies.
- Validation of the usability and applicability framework.

The main part of the research methodology followed a theory building approach by adopting a model from literature (Flynn et al., 1990). The different stages within the research allowed for more detailed and comprehensive development. The initial theory was developed from the literature review, and then modified based on detailed work on specific work packages – some of them related to the EU funded TQM-Tile project– and results from the case studies. The resulting final framework was then further tested using the case studies and its applicability and usability validated, through implementation in one of the participating companies.

Each stage of the research was complemented with work undertaken by the author relating to either exploratory research or diagnostic work. The following section will discuss in detail each of the stages of the research.

7.5.1 Initial Theory Development

The literature review undertaken within this research resulted in the development and investigation of the initial theory. The literature review also established the research hypothesis to be investigated through the developed theory. During the initial theory development the application area of the research of performance measurement system was defined as well as the elements that form the core of the research such as the business objectives, performance measures and factors that affect performance.

The extensive literature study undertaken throughout the course of the research ensured that the research was grounded in theory. It also ensured that the research builds upon existing work and research, thus maintaining the continuity of research in the field. This enhances the validity of the research findings and positions the research problem within the context of established work. Furthermore, the link between theory and the research ensured that all the elements present in the conceptual framework were based on existing thinking in the area of performance measurement and reflect recent changes in the field.

7.5.2 Detailed Development and Case Studies

The initial theory was investigated through a combination of analytical work and case studies. The analytical work undertaken within this research was concerned with work

packages that formed part of the research either internally or externally to the TQM-Tile project the research was undertaken within. One of the most important considerations throughout the course of the research was the alignment of work between the needs of the Ph.D. and the work packages undertaken as part of the TQM-Tile research project. This ensured that there was no duplication of effort and work, and that the time and other resources were utilised to their full extent. Moreover, using the platform of the TQM-Tile project to undertake the research enhanced the research's credibility, validity and ensured greater access to the required information.

The analytical work carried out within each of the steps and work packages discussed in Chapter 4 formed the basis for the detailed development of the conceptual framework carried out during the initial theory development stage of the research. The work packages were either exploratory or diagnostic depending on the needs of the research at that stage, and followed a solid logic reflecting the progress of the research. A number of research actions done solely for the purposes of the Ph.D. were also confirmed or further developed using work packages that formed part of the research of the TQM-Tile project.

The analytical work was complemented by case studies undertaken with industrial companies participating in the TQM-Tile project either directly, or forming part of a wider research group. Case studies were selected to complement the development work mainly because of the flexibility they provide. Case studies added broad range of qualitative data and information that is very helpful in the development and validation of theory (Yin, 1994). The case studies were used in:

- Establishing the industrial validity of the research problem.
- Contributed to the development of framework.
- Validated its applicability and usability.

By using multiple rather than single case studies, it was ensured that generalised conclusions could be potentially drawn depending on the research design. (Yin, 1994), supports that this is an important feature of case study research. It also contributes

significantly to the in-depth investigation of theory-building research (Eisenhardt, 1989).

The use of a case study protocol based on the conceptual framework ensured that data was collected in a structured and systematic way (Flynn et al., 1990). It also ensured the homogeneity of the data collection and comparability between the case studies. The results of the case studies contributed to the final performance improvement framework both at a conceptual level as well as a more detailed level.

7.5.3 Validation of the Usability and Applicability of the Framework

The final stage of the research investigated the validity of the concept and also validated the applicability and usability of the performance improvement framework. This ensured the practical relevance and feasibility of the approach as well as providing an insight into implementation issues. This stage indicated that the performance improvement framework is a valuable tool that could be used to complement the decision making function of an organisation effectively.

The objective of this stage was not statistical validity –the sample size did not permit that– but the in depth investigation of the concept in a real environment. It also confirmed the industrial relevance of the theory development. The company selected was one fulfilling all the application requirements, thus establishing the generic validity of the approach.

7.6 Summary of Discussion

This chapter discussed the findings of the research and also discussed the research development reported in the previous chapters, within the context of the research problem and the research process.

Summarising, the performance improvement framework developed within this research contributes to the wider field of performance measurement through:

- Strategic alignment of improvement actions, factors of performance and measures.
- Identifying factors that affect performance.
- Assessment of the effects of manipulating factors.
- Identifying potential improvement actions.
- Considering strategic trade-offs between factors, actions and measures.
- Understanding the wider impact of improvement actions and performance improvement.
- Improvement of communication within a performance measurement system.
- Increased flexibility and responsiveness.

The validity of the framework was demonstrated through case studies and its implementation in a real environment. The research was based on both theoretical and empirical work thus ensuring the link between theory and practice throughout its duration.

Chapter 8 – Conclusions

8.1 Summary of Research

This research developed a framework that represents the causal relationships between performance measures, improvement actions, their inter-related factors and implementation constraints. Effective use of the framework allows an organisation to align performance improvement actions with their overall business strategy. The framework can be used to manage the performance improvement information in a systematic and structured way. It was tested in a manufacturing process industry environment. A set of web-based tools was developed to help in gaining team participation in the design of the performance measures, factors and constraints.

The framework addresses the challenges of using performance measurement, in particular, not using measurement to seek actions that would deliver strategically aligned improvement. It also provides the theoretical concept to bridge the gap between top-down management imposed improvement initiatives and bottom-up staff led improvement approaches.

The thesis research objective was to develop a framework to identify performance improvement actions, which are in alignment with organisational strategy within a performance measurement system. The framework takes into account the impact that specific actions may have on other areas of performance and forms the basis for collecting and analysing data regarding their impact. The performance improvement framework developed throughout the course of the research is defined and populated with an associated set of tools that were presented in Chapter 5. The research also developed a process to initiate performance improvement using the framework and was demonstrated in Chapter 6. The proposed framework is a practical tool that assists organisations that have implemented a performance measurement system to enhance their decision-making effectiveness.

The performance improvement framework was developed using a combination of theory development and case studies undertaken in companies participating in the EU-

funded TQM-Tile research project. Following the development of the conceptual framework, its applicability and usability were tested on one of the participating companies to ensure its industrial viability and relevance.

Chapter 2 reviewed the relevant literature in the field of performance measurement and performance improvement, setting the foundations for this research. Following the literature review, the conceptual framework underpinning the research was formulated and presented in Chapter 3. Chapter 3 also elaborated the research methodology that was used to investigate the concept. Chapter 4 described and discussed the detailed steps undertaken as part of the research methodology and the development of the framework, from a conceptual stage to its final form. Chapter 5 presented the process and the results of the case studies. Chapter 6 described the process of building and populating the framework and how it can be used within the context of performance improvement. It also presented the validation of its applicability and usability. Chapter 7 discussed the results of this research within the research area and the research process employed.

This chapter draws together the conclusions from the research and discuss its wider relevance and value to the field.

8.2 Research Applicability

The research demonstrates how to establish qualitative cause and effect relationships between different performance measures within the boundaries of a 'well' defined performance measurement system. It also demonstrates how to establish qualitative cause and effect relationships between performance measures and factors that affect them to better understand performance and its causes. The research captured these relationships in a manufacturing environment by using specially formulated relationships matrices that were developed during the research and are discussed in Chapter 5. It also identified factors that affect performance indicators by using cause and effect diagrams. Qualitative cause and effect relationships between factors of performance and potential improvement actions were established using the relationship matrices. In this context, information regarding the improvement actions was identified

and extracted by using data collection forms that were developed throughout the course of the research. The research demonstrates in Chapter 6 how the framework is used to support decision making for performance improvement. The research clearly demonstrated how relevant information found in a 'well' defined performance measurement system, could be extracted by using a set of tools to establish a set of causal relationships. The research demonstrates how this is achieved, in a way that ensures the strategic alignment of lower level improvement actions to the overall business strategy, using the performance data collection forms and the factor and action analysis forms discussed in Chapter 5. The research shows that this results in more explicit, visual and strategically relevant performance measures and improvement actions within a performance measurement system.

During the validation stages of the research reported in Chapter 6 it was demonstrated how the framework can:

- Assess the impact of one performance indicator on another one within the company's performance measurement system.
- Identify which factors should be manipulated in order to improve the performance of a performance indicator.
- Identify the actions that can be taken to alter that factor in line with business objectives and business circumstances.
- Assess the impact of these improvement actions on the overall performance measurement system and overall business strategy.

8.3 Contribution to Knowledge

The reported research within this thesis contributes to both theory and practice. This section discusses the contribution in detail.

8.3.1 Theory

- The research contributes to the field of performance improvement by identifying links between the lower level performance measures and overall business strategy. Consequently, the research complements techniques such as Total Quality Management and Business Process Improvement by identifying the impact of specific improvement actions on overall performance.
- -Within the field of performance measurement the research demonstrates how performance improvement can be focused, in relation to the impact on specific areas of performance.
- The research clearly shows how performance measures, factors that affect performance and lower level improvement actions can be linked to strategic objectives which can be defined generically in terms of Quality, Cost, Time, and Delivery. To this end, the research also demonstrates the complexity of the relationships between the aforementioned elements.
- The research fills the gap for a need of a framework incorporating relationships between performance measures, factors that affect them and performance improvement actions. No such framework exists within the field of performance measurement despite the need having been established in literature (Beischel and Smith, 1991; Feurer and Chaharbaghi, 1995; Kaplan, 1996a). In this context, the performance improvement framework reported in this thesis overcomes the limitations of previous attempts in the wider research field of performance management, by establishing a clear link between improvement and strategy depending on current business circumstances, by extracting information from a performance measurement system in a balanced and comprehensive manner.
- The research demonstrates how performance measures might interact with other measures within a performance measurement system and their impact on overall business strategy. Effectively, the research sets the foundation for further

analysis based on that interaction can be initiated in the context of performance improvement.

- The research builds upon the debate in literature over the existence of trade-offs. While some authors argue for the existence of trade-offs (Skinner, 1969), and others support that they need not exist (Schonberger, 1986), the research adopts New's view in that they do exist in some areas (New, 1992). Furthermore, the research takes the viewpoint of effectively managing these trade-offs by identifying the impact of manipulating factors of performance and improvement actions on overall business strategy.

Graphically, the shaded area in Figure 17 is the domain of established PMS theory. This thesis extends the PI concept to include causal relationship outside the shaded area.

8.3.2 Practice

- Based on the notion that managers make decisions using knowledge based on a combination of experience and theory (Kennerley et al., 1996; Gill and Johnson, 1997), the research makes a contribution to practice regarding decision-making by establishing the links between performance measures, improvement actions and factors of performance during decision making.
- The framework can allow the management of trade-offs in performance improvement decisions, by allowing a wider perspective to be adopted. This can be achieved by providing a better understanding of the impact of improvement actions over business objectives.
- The framework can allow the management of resources needed for performance improvement within the context of performance measurement and in alignment with the overall business strategy.
- The framework can promote the alignment of improvement actions in all areas of the organisation by making their strategic relevance and impact more visible and explicit. Thus the focus of efforts within the business can be concentrated on the realisation of strategy.

- The impact of improvement actions can be used to identify improvement actions that have the greater impact on the desired area of performance and in alignment with business strategy.

8.4 Research Limitations

To have a better understanding of the context that this research was undertaken within, it is important to consider the limitations acknowledged throughout its course.

- The qualitative nature of the research cannot ensure the statistical validity of the information used to populate the performance improvement framework. Although it can be argued that statistical validity cannot be achieved without establishing a qualitative model first, this clearly reflects the complexity of the relationship between factors and performance.
- The relationships are based on subjective judgement. It could be argued that it would be impossible to have objective measurement under these circumstances (Suwignjo et al., 2000). The research has used multiple opinions to establish relationships during the case studies to limit the effect of subjectivity.
- The number of the companies studied was relatively small. However, the characteristics the companies demonstrated allows for some generalisation of the conclusions (Yin, 1994).
- The performance improvement framework relies upon a 'well' defined performance measurement system for the information it is populated with. However, in practice a 'well' defined performance measurement system might be a difficult platform to achieve. Consequently, the quality of the design of the PMS directly affects the effectiveness of the framework.
- The timescale and the size of the validation process were linked to the scope of the TQM-Tile project. However, the research assumed sufficient depth during the validation process so that conclusions drawn are research valid.

8.5 Further Research

- The research reported here was mainly developed for the use of a performance measurement system in manufacturing organisations. It would be of value to

study the application of the framework in service organisations where the performance measures are 'softer' in their definition and information could be harder to collect and define (Brignall and Ballantine, 1996).

- It should be possible to use the qualitative nature of the framework to establish a quantitative model of relationships but that could potentially need a large number of studies and data requirements.
- The ability to assess the impact of an improvement action on a measure of performance might imply that under certain circumstance it would be possible to predict the change in the level of performance of a measure. This would be possible especially in situations where both leading and lagging indicators in a performance measurement system has been established. To this end, it should be possible to build a model populated with improvement actions versus resources used versus effect on specific measures of performance, that over time could acquire the volume of data to establish confident relationships.
- The computerisation of the model should be of benefit not only to the management of data collection, but also to the understanding and presentation of the performance improvement framework. It should be possible to develop a database of relationships that would both facilitate the implementation of the framework but also contribute to further development stated in the previous point. Integrating the performance improvement framework within an executive information system should be investigated.

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Appendix I: Summary of PMS Design Methodology

Management tools help set up business Performance Measurement System

Keywords/Processes: **Performance Management, Business Process, Continuous Improvement, Business Excellence, Total Quality Management**

Project Details
Acronym: TQM-Tile
Duration: 31 months
End Date: January 2001

TQM-Tile developed a set of management tools to support organisations set up a business process performance system for managing their performance. The tool set enables a business (a) establish a systematic understanding of its operations via its business processes and (b) manage its performance measures.

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PROJECT DESCRIPTION

The project was initiated to develop a methodology and supporting tools to help businesses to focus on customer value. This is achieved by the integration of their business process and performance measurement system. The methodology guides an organisation to develop its business processes in line with its mission and vision by decomposing and classifying its business processes to provide a clear picture of its operations. The business process focus is part of the Business Excellence model in ISO 9000:2000. The software tool developed supports the implementation of an integrated model to provide instantaneous information on the state of the different business processes. Process based performance measures with 'real time' information allows business to pre-empt problems. Improvement initiatives and actions could be fully justified, leading to continuous improvement. The project brings together best practices in process and performance management and a practical, validated methodology to achieve performance management through process management.

TECHNICAL DEVELOPMENTS

PIPE, a new business development methodology has been developed to help organisations to implement and use process-based performance management. The methodology is innovative and integrates performance and process management perspectives to allow a better understanding of organisational processes and how they contribute to the business. The implementation and the use of the methodology is supported by a software application, **ten**, which can be fully integrated into organisation's information systems.

PIPE uses the Plan-Do-Check-Act cycle via four phases: (a) Covering Design and Implementation of the Performance Management System (PMS), (b) Operating PMS and collecting operational data, (c) Reviewing results and analysing indicator relationships and (d) Carrying out identified actions.

PROJECT DELIVERABLES

The following two commercial products have been developed as a result of the project:

- **PIPE** - Performance Improvement through Process Excellence – a comprehensive, performance management tool to help an organisation build a process based performance management system. A complete diagnostic of the current situation and a plan to cover any gaps identified in the organisation is provided.
- **ten** - A new software application to allow an organisation take a systematic approach to improve its performance. It helps the business to define and focus the strategies, objectives and initiatives that drive improvements, and to gather, monitor and communicate the data that measures progress.

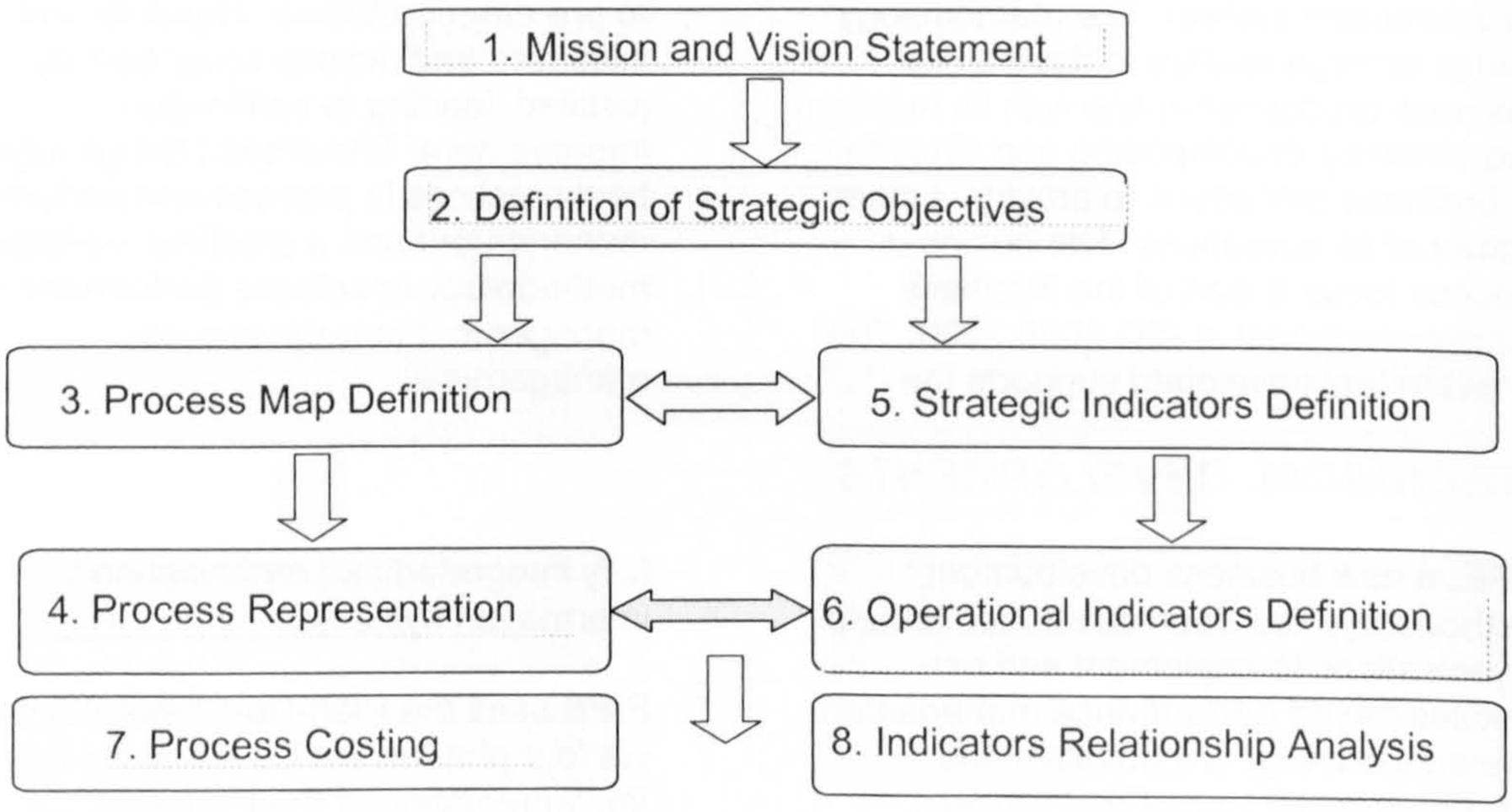
EXPLOITATION AND BENEFITS

The partners in United Kingdom are actively exploiting the results of the research as follows:

Cranfield Manufacturing Business Consultancy has achieved success in taking **PIPE** to the market. **PIPE** is now used as a standard module in the Merseyside Business Link Manufacturing Excellence programme to assist SMEs improve competitiveness. ColorMatrix Europe has been trained to use **PIPE** in the first phase of this programme. As part of its Strategic Direction programme the Welsh Development Agency is also considering the **PIPE** methodology.

PIPE had been introduced to more than 40 business advisors from **Business Links** across the country with more programmes expected to come on line. The experience of the consultants is shared through regular masterclasses in Cranfield, through which over 50 directors and senior managers have learnt about **PIPE**.

Business Integration Technologies Limited has used the project results to develop a new commercial performance management product, **ten**, and formed a new spin-off company, **ten** Software, to market and sell **ten** and associated services through a network of partners.



PERFORMANCE MANAGEMENT SYSTEM DESIGN STEPS

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Department of Trade and Industry

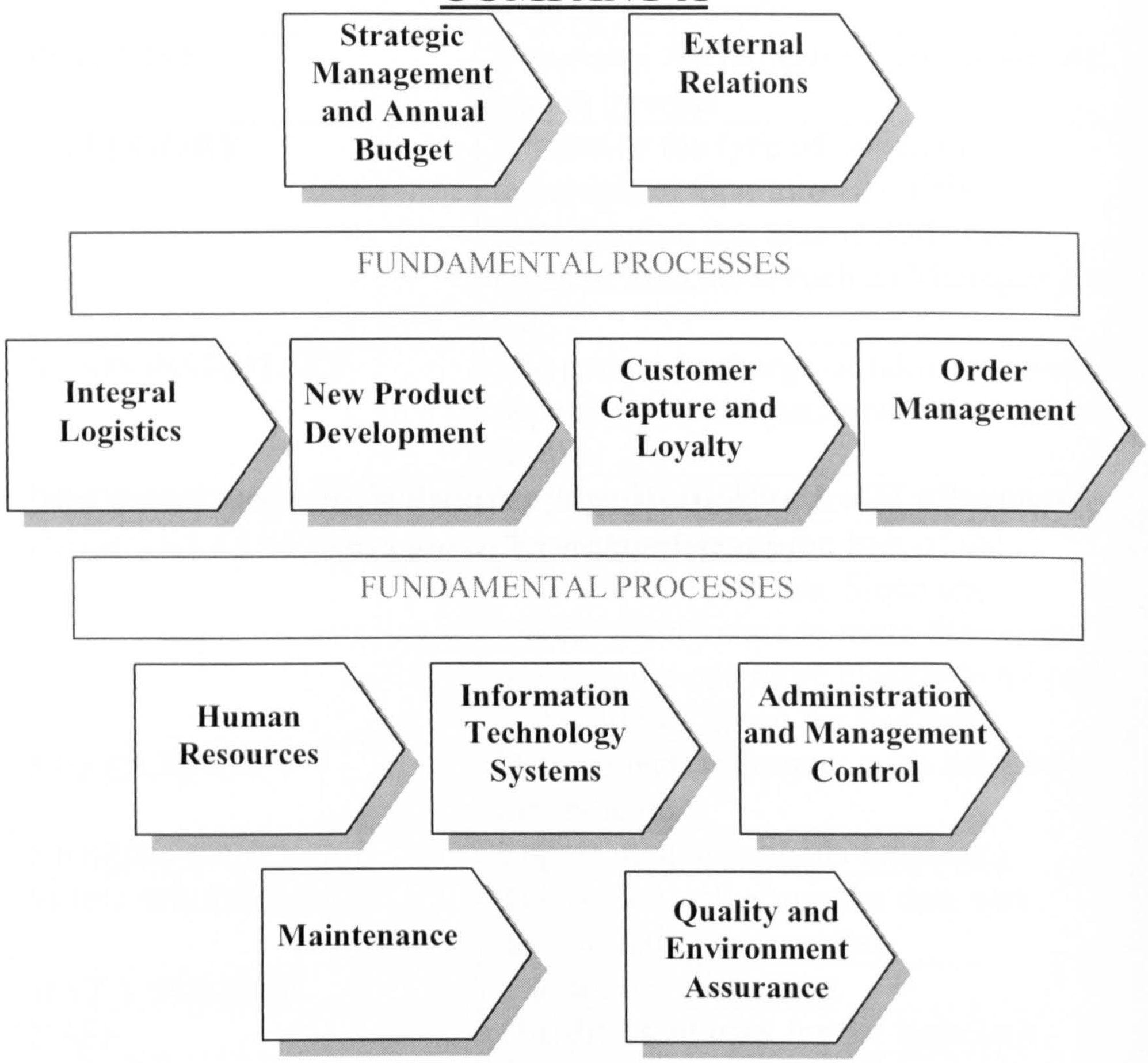
MANIST
Manufacturing in IST

Appendix II: Performance Indicator definition fields

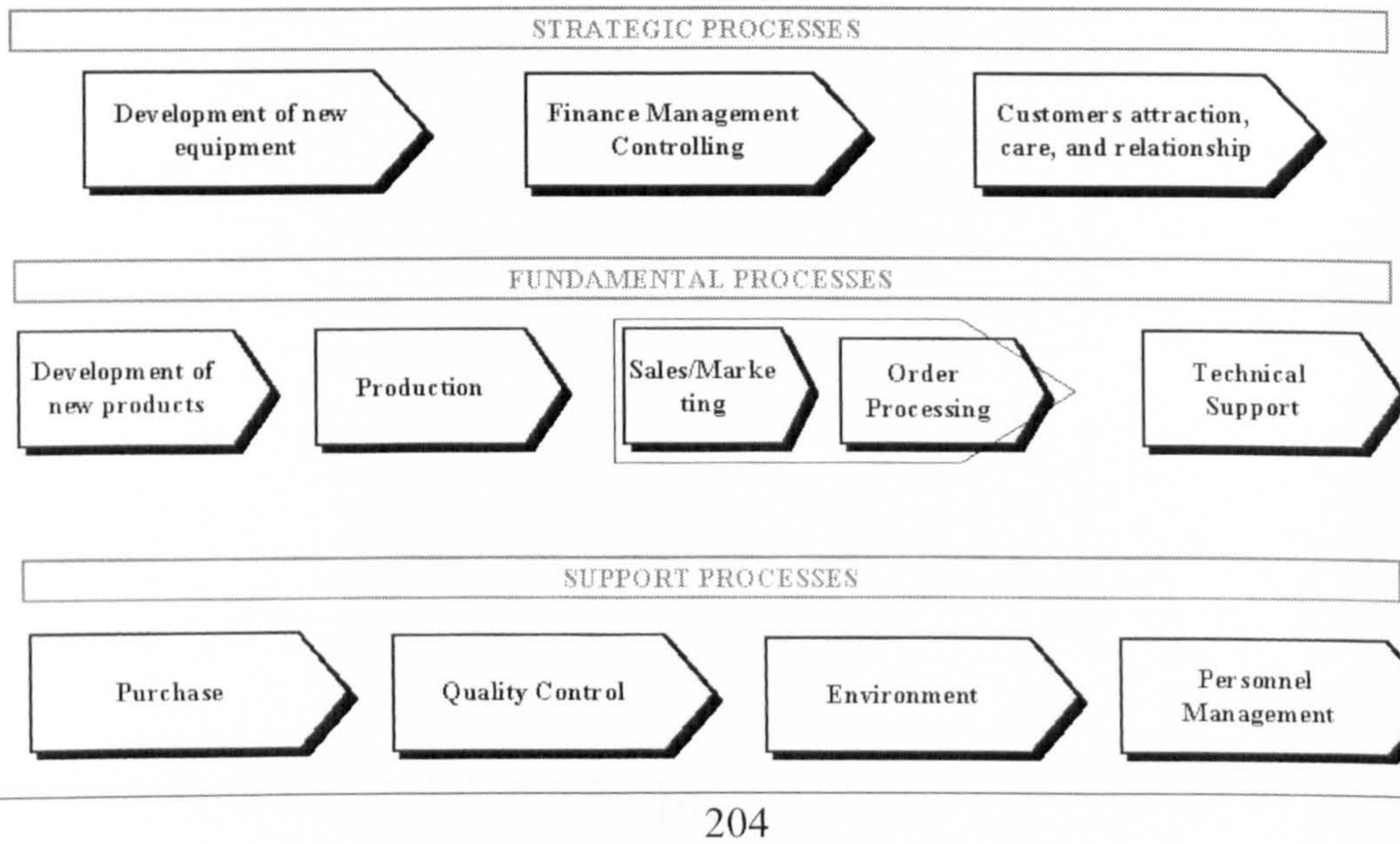
Field	Explanation
NAME	This is the title of the indicator. It must be clear and simple.
PURPOSE	It explains the indicator's objective, the reason it exists.
CATEGORY	It refers to the type of indicator (Strategic or Operational). This classification can also include other types of indicators such as Management etc.
RESPONSIBILITY	The person in charge of taking actions depending on the performance measure results.
DEFINITION/FORMULA	Mathematical definition of the indicator.
PROCESS LINKED	This field refers to the link of the indicator to a process. Since one indicator can relate to more than one process, the one more closely linked to it should be chosen for this field.
FREQUENCY 1	Data collection frequency to calculate the indicator.
FREQUENCY 2	Reporting and analysis frequency.
WHO MEASURES?	The person collecting the data and consolidating the results.
DATA SOURCE	The source of the data.
USES	The different uses for the indicator.
TARGET	The desired level of performance.
OTHER COMMENTS	Other information that can be included.

Appendix III: Participating companies' process maps and classification of processes

COMPANY A



COMPANY B



- **Strategic processes:** These processes are very closely related to the company's Mission and Vision and affect the entire organisation, managing other processes.
- **Fundamental processes:** They cut across many functions and create value for the customers and shareholders. They have a great impact on the final customer. These processes are the most important part for the company running and in the development of organisational capacities. Their objective is not to manage other processes, but to obtain results.
- **Support processes:** They provide support to fundamental processes and they are usually included in a specific function. Their customers are internal.

Appendix IV: Performance data collection form

PERFORMANCE DATA COLLECTION FORM

Indicator name: _____

Purpose: _____

Indicator Type: _____

Relevant objectives: _____

_____

Possible factors affecting the indicator	Unit of measurement

Person acting upon _____

Authorisation level _____

Other _____

Appendix V: Factor & action analysis form

FACTOR AND ACTION ANALYSIS FORM

Indicator name:			Owner:					
Possible factors affecting indicator	Unit of Measurement	Relevant Action	Time Element	Cost Element	HR Element	Author. Level	Control	Approximate impact
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	
			H M L	H M L	H M L		Y N	

KEY:

H= HIGH
M= MEDIUM
L=LOW
Y=YES
N=NO

Appendix VI: List of Indicators used by Company A

COMPANY A INDICATOR LIST

INDICADORES	INDICATORS
% 1ª CALIDAD NUEVOS PRODUCTOS	FIRST QUALITY NEW PRODUCTS %
% CLIENTES FIELES PERDIDOS	% OF LOST LOYAL CUSTOMERS
% HORAS PROGRAMACIÓN LIZADAS / PRES PRESUPUESTO N	PROGRAMMING HOURS % /BAAN BUDGET
% PEDIDOS DEVUELTOS	RETURNED ORDERS %
% VENTAS DE LOS CLIENTES FIELES PERDIDOS	% OF LOST LOYAL CUSTOMERS SALES
ABSENTISMO	ABSENTEEISM
AHORRO EN COMPRAS	SAVING IN PURCHASING (MILLION PTAS.)
BECAS Y PRÁCTICAS	GRANTS AND STAGES
CF SOBRE INGRESOS DE LA EXPLOTACIÓN	CASH FLOW ON SALES
COBERTURA	AVAILABLE STOCK TIME
CONOCIMIENTO DE MARCA	BRAND KNOWLEDGE
CONSUMO DE CEMENTO	CEMENT CONSUMPTION
COSTE DE LA PRIMERA CALIDAD	FIRST QUALITY COST
COSTE DE LOS PRODUCTOS (ptas./ m2)	COMPANY A PRODUCT COST
COSTE GLOBAL PROMOCION COMPANY	GLOBAL COMPANY A PROMOTION COST
COSTE PANELES DE MUESTRA	SAMPLE PANEL COST
COSTE PERSONAL SOBRE Nº EMPLEADOS	STAFF COST ON NUMBER OF EMPLOYEES
COSTE RECLAMACIONES	CLAIMS COST
COSTES MEDIOS ESMALTES NUEVOS PRODUCTOS	AVERAGE COST OF NEW PRODUCTS GLAZES
CUMPLIMIENTO DEL PROGRAMA DE PRODUCCION EN 4 SEMANAS	4 WEEKS PRODUCTION PROGRAM ACCOMPLISHMENT
DÍAS DE ADELANTO /RETRASO PLANIFICACIÓN BAAN	DELAY ADELANTO IN THE BAAN PROGAMM
ENDEUDAMIENTO SOBRE FONDOS PROPIOS (sin descuentos)	INDEBTEDNESS ON EQUITY (without bank discount)
ENDEUDAMIENTO SOBRE FONDOS PROPIOS (con descuentos)	INDEBTEDNESS ON EQUITY(with bank discount)
ENDEUDAMIENTO/ CASH FLOW	INDEBTEDNESS ON CASHFLOW
ESTRUCTURA SOBRE MARGEN	OVERHEADS /MARGIN

EVOLUCIÓN DE PICOS	PICKING EVOLUTION
FIABILIDAD DEL STOCK	WAREHOUSE STOCK RELIABILITY
FORMACIÓN	TRAINING
GESTIÓN DE PEDIDOS NO ASIGNADOS	NON ASIGNED ORDER MANAGEMENT
GESTION DE RESERVA DEL MATERIAL	MATERIAL RESERVATION PROCESS
INCREMENTO VENTAS (%)	INCREASE IN SALES %
INICIO DE OBRA	BEGINNING OF CONSTRUCTIONS
INNOVACIÓN (Artículos de las dos últimas campañas)	INNOVATION (2 LAST CAMPAIGNS ITEMS)
INNOVACIÓN	INNOVATION
INVERSIONES SOCIALES	SOCIAL INVESTMENTS
LEALTAD DE LOS CLIENTES	CUSTOMERS LOYALTY
MARGEN BRUTO INDUSTRIAL	GROSS MARGIN ON SALES
MARGEN NETO INDUSTRIAL	NET MARGIN ON SALES
MEDIDAS MEDIOAMBIENTALES	ENVIRONMENTAL ACTIONS AND ENERGY SAVING
Nº DE CLIENTES NUEVOS	NUMBER OF NEW CUSTOMERS
Nº DE CLIENTES PERDIDOS	NUMBER OF LOST CUSTOMERS
Nº DEFECTOS	NUMBER OF DEFECTS
Nº PEDIDOS INCORRECTOS PROMOCIONES	NUMBER OF ERRORS IN PROMOTION ORDERS
Nº RECLAMACIONES	NUMBER OF CLAIMS
PÉRDIDAS DE MATERIAL	WASTAGES IN MATERIAL
PLAZO DE ENTREGAS	DELIVERY TIME
PLAZO MEDIO DE COBRO	CUSTOMER PAYMENT AVERAGE TIME (DAYS)
PLAZO MEDIO DE PAGO (días)	SUPPLIER PAYMENT AVERAGE TIME (DAYS)
PLAZO PRIMERA PRODUCCIÓN NUEVOS PRODUCTOS	NEW PRODUCT FIRST PRODUCTION LEAD TIME
PRECIO MEDIO DE VENTA (ptas./ m2)	COMPANY PRODUCT AVERAGE SELLING PRICE
PRODUCCIÓN DE LA PRIMERA CALIDAD	FIRST QUALITY PRODUCTION
RENDIMIENTO DE LA EXPLOTACION/ INGRESOS EXPLOTACION	EARNING ON SALES
RENTABILIDAD SOBRE FONDOS PROPIOS (ROE)	RETURN ON EQUITY (ROE)
RONA (RENTABILITY ON ASSETS)	RONA
SATISFACCIÓN DE CLIENTES	CUSTOMER SATISFACTION ENQUIRIES
SERVICIO AL CLIENTE (%)	CUSTOMER SERVICE

SERVICIO AL CLIENTE DE PROMOCIONES	CUSTOMER SERVICE IN PROMOTIONS
SOLVENCIA TECNICA	SOLVENCY
STOCK DISPONIBLE	AVAILABLE STOCK
STOCK UTIL DISPONIBLE	USEFUL AVAILABLE STOCK
TIEMPO FABRICACION NUEVOS PRODUCTOS	NEW PRODUCTS FIRST PRODUCTION LEAD TIME
TIMPO DE OCUPACIÓN LÍNEA FABRICACIÓN NUEVOS PRODUCTOS	LEAD TIME IN NEW PRODUCTS MANUFACTURE
VENTAS SOBRE ACTIVO TOTAL	SALES ON TOTAL ASSETS
VENTAS SOBRE MASA SALARIAL (mptas./empleado)	SALES ON WAGES
VENTAS SOBRE Nº EMPLEADO (mptas./empleado)	SALES ON NUMBER OF EMPLOYEES
ROTACION DE MATERIAS PRIMAS	RAW MATERIALS TURNOVER
STOCK CLASES BAJAS (ECONÓMICA, COMERCIAL,LIQUIDABLES)	ECONOMICAL STOCK
INDICADORES FINANCIEROS DE BENCHMARKING	BENCHMARKING FINANCIAL INDICATORS

Appendix VII: Case study format

Objective of the case study format

The objective of the case study format is to establish and present the framework that will be used during the data collection and analysis phases of the research. The case study format will be used to structure the data collection and the case study interviews as well as categorising the relevant information for the compilation of reports. The standardisation of the format of this information will also facilitate comparisons between companies. The level of information and detail required and investigated by the case studies, is reflected by the questions contained in the case study format.

Structure

The case study format is divided into four different sections depending on the required information. Section one consists of questions investigating the background of the participating company. This section investigates the strategic orientation of the company as well as obtaining necessary background information. Additionally, the establishment of the company's strategic objectives forms the basis for the remainder of the interviews.

Section two consists of questions investigating the company's approach to performance measurement, including the design, use and implementation of their performance measures. Section three includes questions concerning the company's approach to performance improvement within the performance measurement system and finally, section four investigates causality (i.e. relationships) within the company's PMS.

Objectives

- Investigate the company's attitude and maturity in the field of performance measurement in regards to their strategy.
- Assess the critical issues in the performance measurement system of the participating companies.
- Assess the understanding of causality within the performance measurement system of the participating companies.
- Assess the understanding of manipulating factors affecting performance measures within the performance measurement system.

- Investigate the process of performance improvement within the performance measurement systems of the participating companies.
- Assess the availability of resources needed to initiate performance improvement.

The above objectives will be met by undertaking case studies in the participating companies in different areas of their performance measurement systems, reflecting different aspects of performance measurement using the format presented.

Data Collection

The process of data collection will be undertaken using semi-structured interviews with the owner of each of the processes within the companies as well as other relevant personnel. The interview structure followed is presented in detail in the case study format.

Section 1: Introductory Interviews

The introductory interview is designed to extract background information about the company. The underlying concept is that collecting high-level strategic information will enable the investigation of how this devolves to lower operational levels within the company's performance measurement system. It will also contribute to understanding the state of the strategic relevance of improvement actions within the company. Furthermore, at this stage the establishment of long, medium and short term perceptions within the companies will aid in the understanding of how particular strategic objectives are achieved through the undertaking of improvement actions.

The performance measurement system already defined within the companies will be used as the platform on which to base the data collection and analysis. The structure and detailed content of the introductory interviews is as follows:

Background Information

Company Name:

Industrial Sector:

Type of products:

Product range:

Business environment: MTS, MTO, etc.

Turnover (Annual):

No. Of Employees:

Company's image in market:

Company's position in industry (Sales): Top 10%

Main 80%

Bottom 10%

How's is performance generally measured within the company?

State the time horizon for what within the company is characterised as:

Short term _____

Medium term_____

Long term_____

Are there any initiatives undertaken recently (External or internal) that are really important to the company?

If yes, briefly describe_____

What were the main achievements of these initiatives?

Strategy and organisation

What is the company's mission and vision statements?

What is the company's strategy?

What are the company's critical success factors?

What is the company's organisational layout/structure?

How is the management structure organised?

Business environment

What type of market is the company in?

What market share does the company hold?

What is the nature of demand?

How is demand affected in this market?

Section 2: Main Interviews

The main interviews form the basis on which the research modifications to the initial framework will be undertaken. The following questions will be asked to each process owner or alternatively to process managers, within the performance measurement system of the companies.

Performance Measurement

1) What are the performance indicators used in this process?
2) How are the indicators calculated?
3) How is the data collected?
4) How frequently is the data collected?
5) How frequently are the indicators reported?
6) How are the indicators reported?
7) Which of the indicators of performance do you consider to be controllable?
8) How much control do you believe that you have over the performance indicator?

☐Full ☐Some ☐None ☐Depends

9) Does the owner of the performance indicator have the authority to take the necessary action to improve performance?

☐Yes ☐No ☐Depends on the action

10) Does the owner of the measure of performance have the necessary tools and skills to undertake the necessary action to improve the indicator?

☐Yes ☐No ☐Depends on the action

11) Does the owner of the measure of performance have the necessary information to undertake the necessary action to improve the indicator?

☐Yes ☐No ☐Depends on the action

12) How is the need for action identified?
13) What action is taken?
14) How frequently is action taken?
15) Who takes action?
16) How is the target set?
    - internally or externally?

- what criteria are used?
- who is responsible for setting the target?
- when are targets reviewed?

17) What problems are encountered when trying to achieve the targets for performance indicators?

18) Other information you think is relevant

_____

_____

_____

_____

Performance Improvement

19) Are factors affecting performance considered in performance improvement?

☐Formally ☐Informally ☐Not at all

20) Is the strategic relevance of improvement actions explicitly considered during performance improvement?

☐Yes ☐No

21) Is the strategic impact of improvement actions explicitly clear during performance improvement?

☐Yes ☐No

22) Is there a need to consider them in a structured way?

☐Yes ☐No

23) Would you foresee benefits from such an approach?

☐Yes ☐No

If yes, then what possible benefits do you foresee?

_____

_____

_____

_____

_____

24) Are resources considered when undertaking performance improvement actions?

☐Yes ☐No

25) If yes, is this done?

☐Formally ☐Informally

26) Which do you think are the major resources categories needed to undertake performance improvement actions?

27) Do you think quantification of resources needs is a feasible/usable task?

☐Yes, definitely ☐Absolutely Not ☐Possibly

28) Is the relevant information easy to collect?

☐Yes ☐No

29) Is information regarding resources readily available as part of another measurement process or within the company's PMS?

☐Yes ☐No

30) What do you see as a usable approach for assessing the resources needed to undertake a specific improvement action?

- Percentage ☐
- Score ☐
- High, Medium, Low scale ☐
- Other_____

31) Which technique you feel would assist in the structuring of the process of identifying factors affecting a performance indicator?

- Brainstorming ☐
- Cause and effect diagram ☐
- Prioritisation ☐
- Intuitive ☐
- Cognitive mapping ☐
- Tree diagrams ☐
- Other, please state

Causality

32) Are factors of performance and performance indicators clearly linked within the performance measurement system?

☐Yes ☐No

33) Are potential improvement actions and performance indicators clearly linked within the performance system?

☐Yes ☐No

34) Are there explicit links between the company's strategic objectives and performance indicators?

☐Yes ☐No

35) Are there explicit links between the company's strategic objectives and performance improvement actions?

☐Yes ☐No

36) Have the factors that affect performance been identified formally within the performance measurement system?

☐Yes ☐No

37) Has the effect of manipulating these factors been assessed within the performance measurement system?

☐Yes ☐No ☐N/A

38) Other information you think is relevant

Appendix VIII: Summary of Case Study results

This appendix summarises the results of the case studies and their significance to the research. The detailed results are discussed in Chapter 4. The analysis is divided into four sections:

1. Case study results regarding performance measurement within the participating companies
2. Case study results regarding performance improvement and how it is undertaken within the companies
3. Case study results regarding causality within the companies' performance measurement systems.
4. Case study results regarding the use of the performance improvement framework and the tools employed.

Performance measurement

The results show that the companies illustrate consistency in the definition and design of performance indicators as dictated by the PMS design methodology they had adopted. The information requested was readily available and the companies were clear as to who owns, is responsible and acts on performance indicator. Moreover, during the data suggests that the information and the tools and skills needed to take action based on the level of performance of an indicator do exist within the performance measurement system. Additionally, one of the major problems encountered when striving to achieve a set target is the lack of understanding of the impact on the whole performance of the company.

Performance Improvement

The case study findings indicate that despite the companies' mature approach to performance measurement, factors of performance are not explicitly considered within the performance measurement system. Consequently, the strategic relevance of improvement actions is hard to fully consider. To this end the companies do recognise the need and see benefit from doing so in a structured way that could be incorporated in their decision making function. To this end the findings companies suggest that a cause and effect diagram is the preferred choice for identifying factors that affect

performance. They also feel that quantification of resources needed to undertake an improvement action is a complex task with the information required being difficult to collect and instead the High, Medium, Low approach is much preferred.

Causality

The case study findings indicate that despite strategic objectives being considered during the design stages of the performance indicators, there is no clear link between them and the improvement actions that might be initiated by these indicators. Furthermore, there are no explicit links between factors of performance and improvement actions and the factors are not formally considered within the performance measurement system. Additionally, there is no formal consideration of the effect of manipulating those factors.

Appendix IX: Detailed case study results

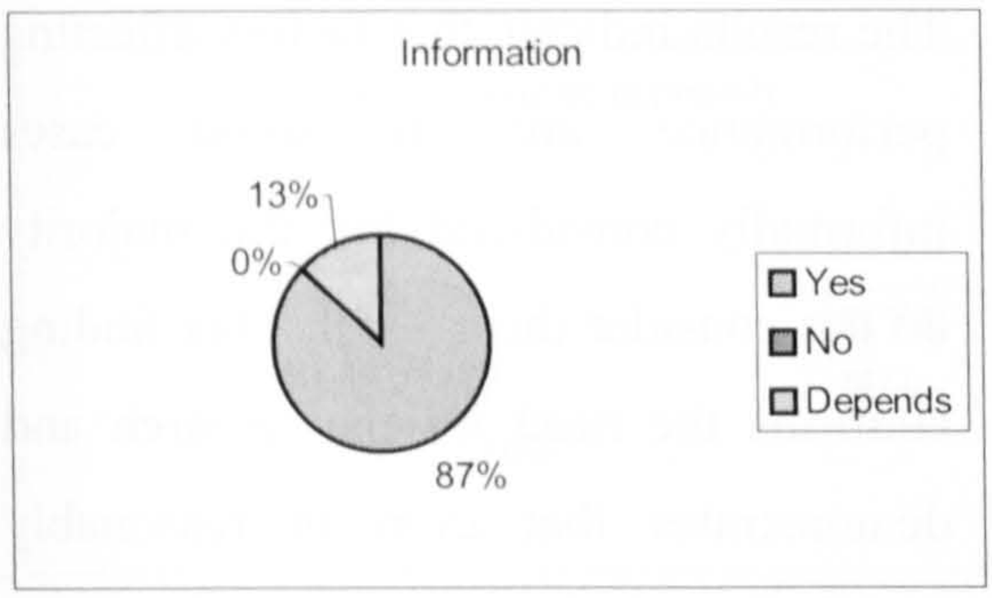
The case study results are split into the following section regarding the relevance to the research:

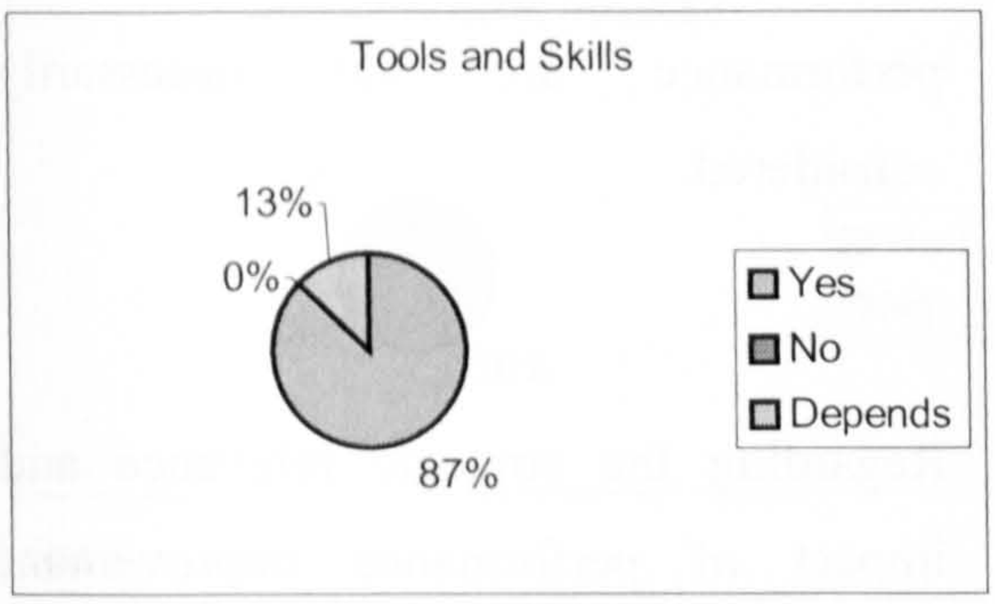
- Performance Measurement
- Tools and skills needed for performance improvement
- Factors of performance and strategic relevance of improvement actions
- Need/Validity and benefits of the approach
- Resources consideration
- Factors and resources assessment
- Causality

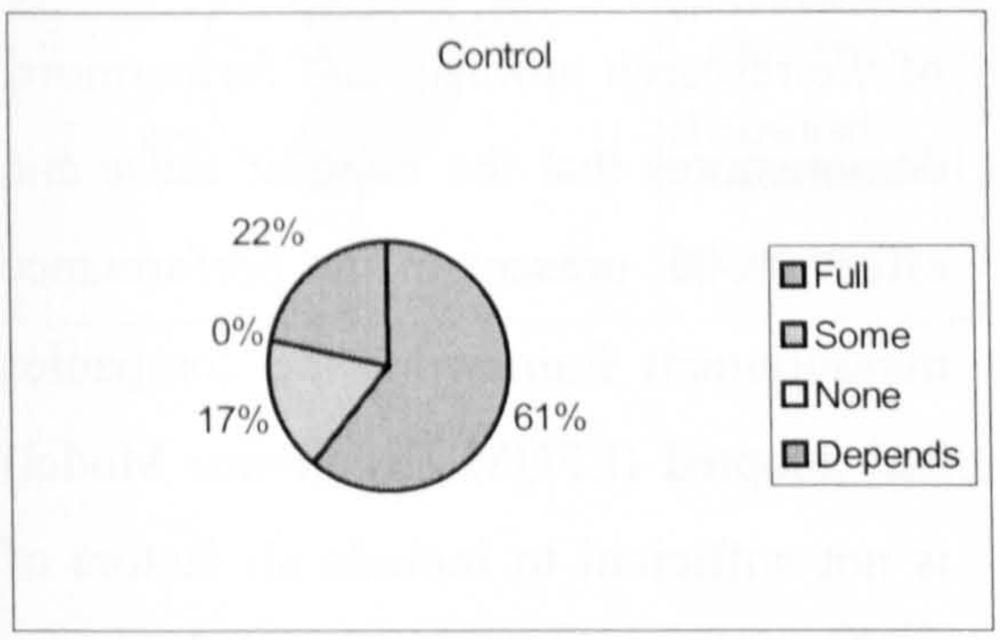
The first section of the case study results contains the observations relating to the companies overall attitude towards performance measurement. This section is presented in the form of a discussion about the overall findings since they relate directly to the environment of the framework.

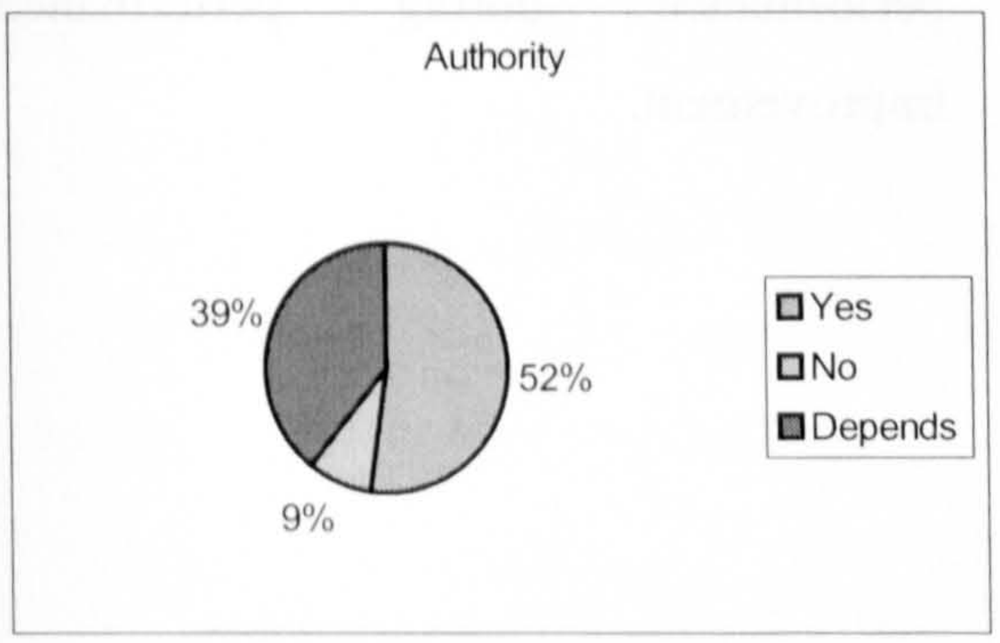
Performance Measurement

The companies demonstrated relative maturity in the understanding of concepts such as strategy and performance measurement. Their practises were largely consistent with 'good' design guidelines in the field of performance measurement, and the knowledge available within their performance measurement system was utilised quite effectively. However, as the case studies indicate the strategic relevance and impact of lower level activities in general was not very clear. Moreover, in spite of the guidelines for 'good' design practices having been implemented the running of the performance measurement system indicated that in some isolated instances these were not being followed i.e. sometimes the definition of the indicators was based on and ad-hoc approach. This showed that the performance measurement culture, although mature, was not fully instilled in every part of the business. The framework clearly contributes in the field in that respect.



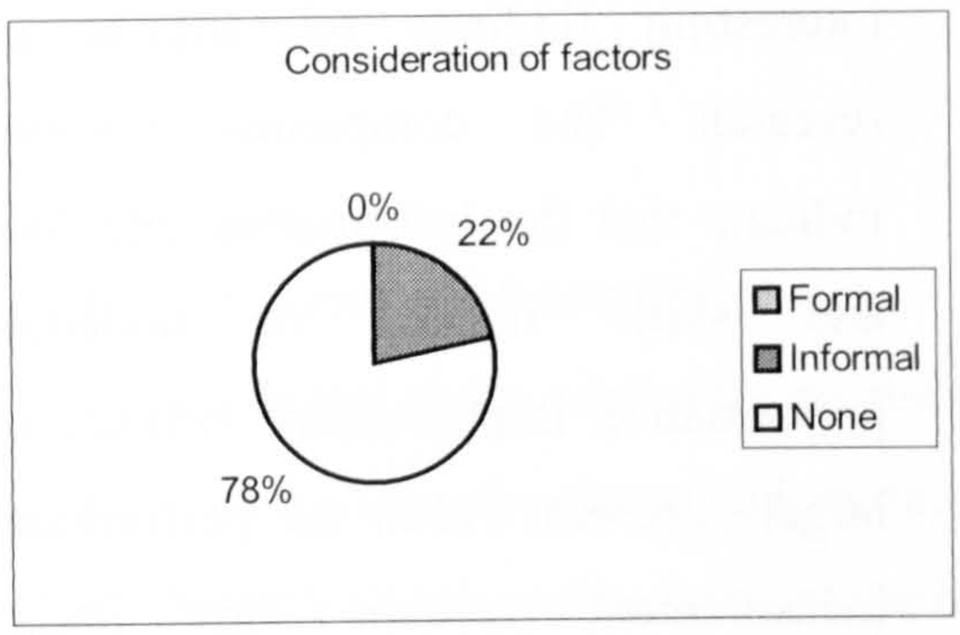




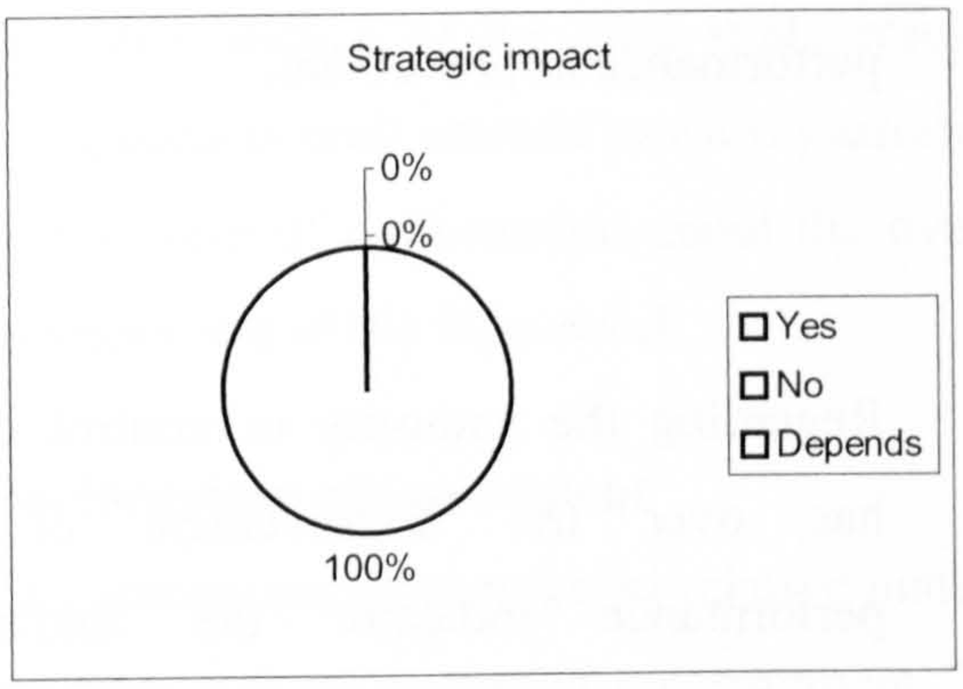


The results indicate some very interesting findings relevant to the research. The companies involved indicate that the information and tools and skills needed to undertake performance improvement actions are largely present within the performance measurement system. This finding confirms the research assumption stating that relevant information could be made available within the company's PMS and confirms the stature of managers as the main driving force in performance improvement.

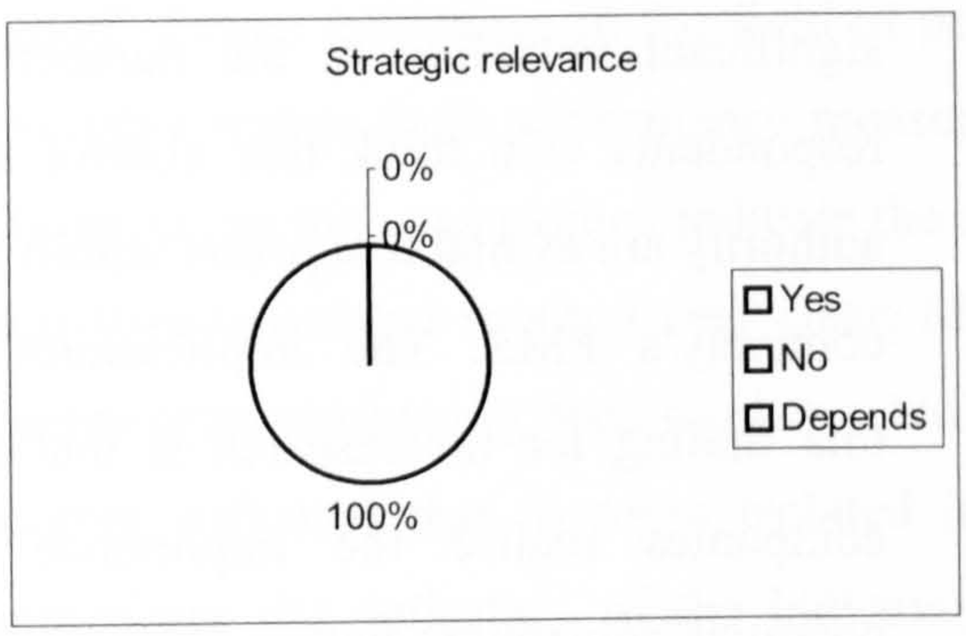
Regarding the authority or control one has over the improvement of a performance indicator the findings portray a different picture. There is a significant reduction in the number of respondents who think that control and authority are available *a priori* within the company's PMS. The implications of this finding for the research is that the companies realise the importance of potential constraints within performance improvement actions. It also implies that for the performance improvement framework to be comprehensive these are elements that should be included within its structure.

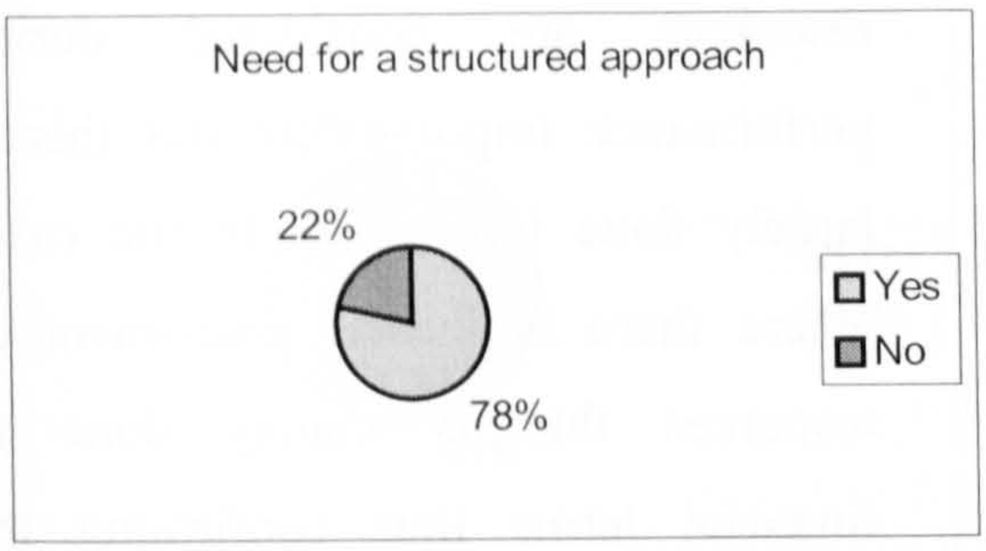


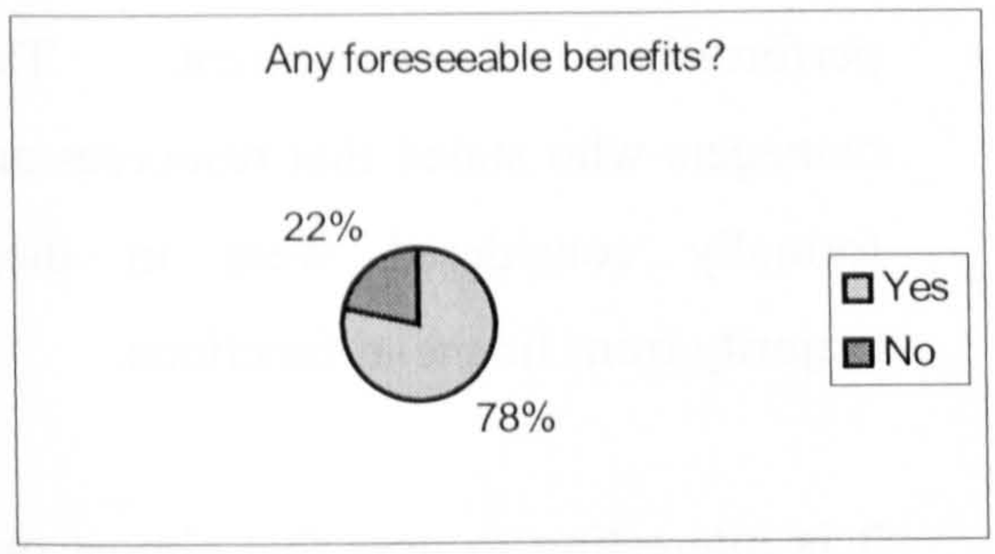
The results indicate that factors affecting performance are in some cases informally considered but the majority do not consider them at all. This finding confirms the need for the research and demonstrates that even in reasonably 'well' designed performance measurement systems, factors of performance are not necessarily considered.

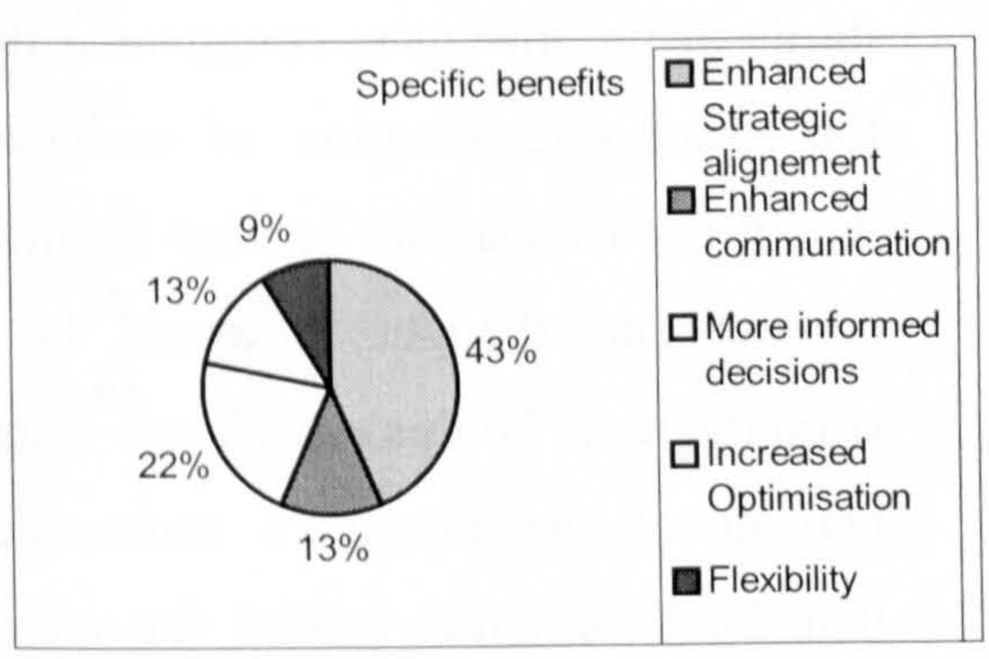


Regarding the strategic relevance and impact of performance improvement actions, these are not explicitly considered in any of the companies. Again, this finding confirms the validity of the research problem and furthermore, demonstrates that the implicit cause and effect model present in the performance measurement framework the companies had adopted (EFQM Excellence Model) is not sufficient to include all factors of performance during performance improvement.





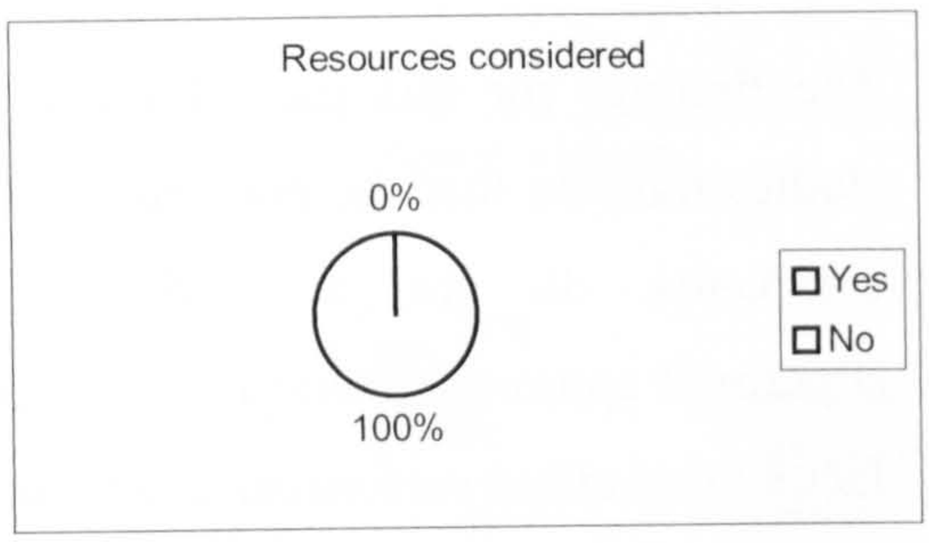


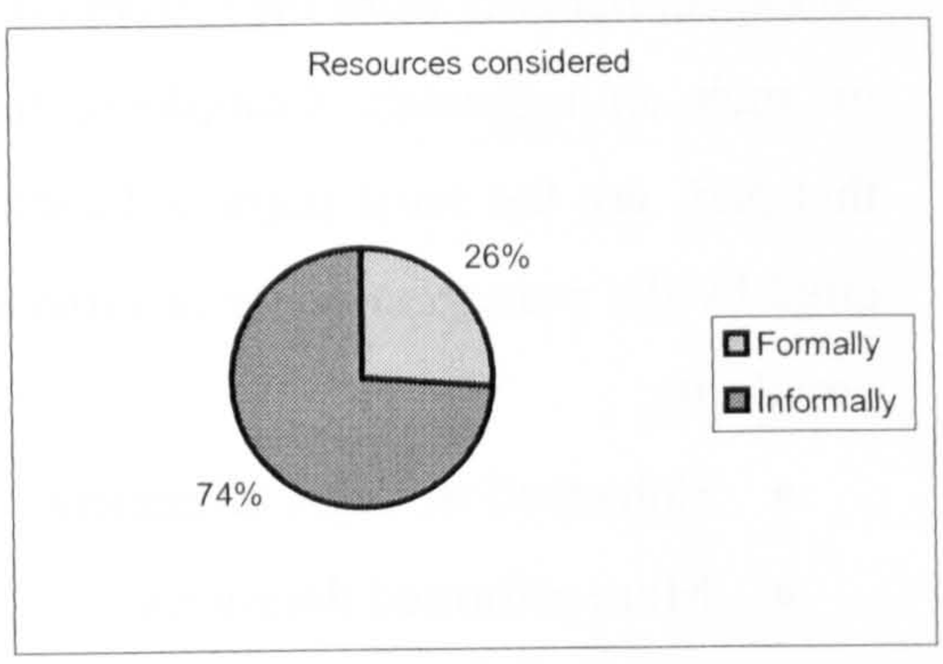


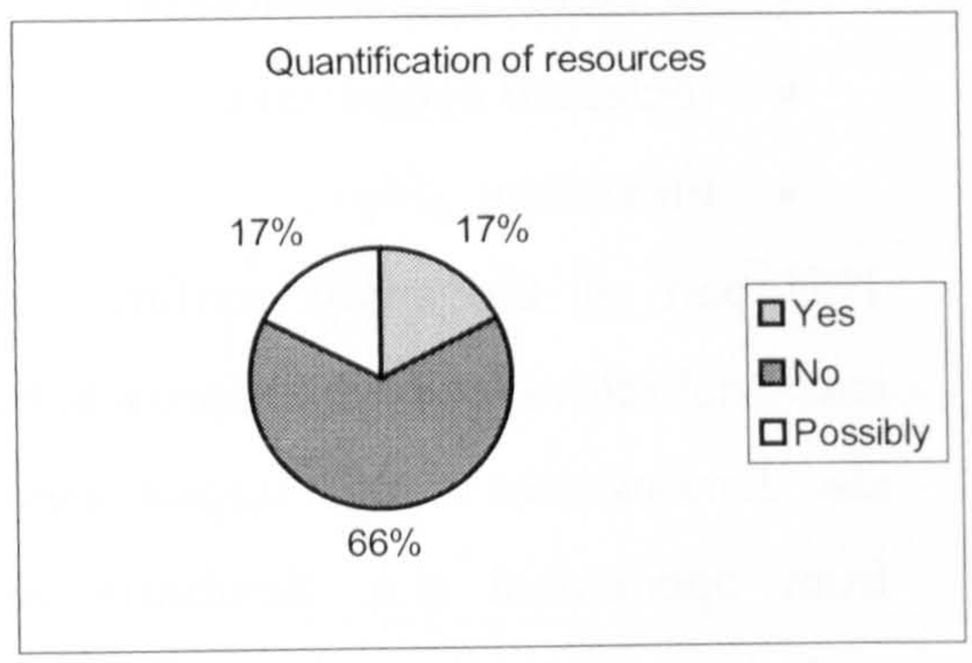
The findings for this part of the case studies indicate that the majority of the companies do see a need for a structured approach taking into account factors that affect performance, and also do expect benefits from the introduction of such an approach. Complementing this part, are the most popular benefits cited by the managers being in order of popularity:

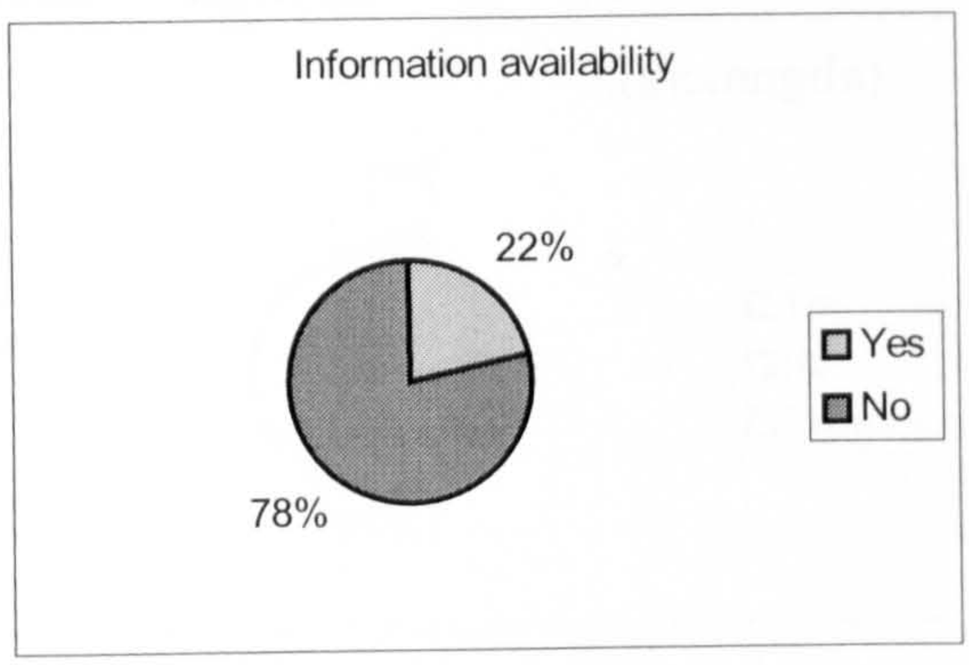
- Enhanced strategic alignment
- More informed decisions
- Enhanced communication
- Increased optimisation
- Flexibility

This part of the study confirms the industrial relevance of the approach, but also demonstrates that the impact spans from operational (i.e. flexibility and optimisation) to strategic issues (alignment).



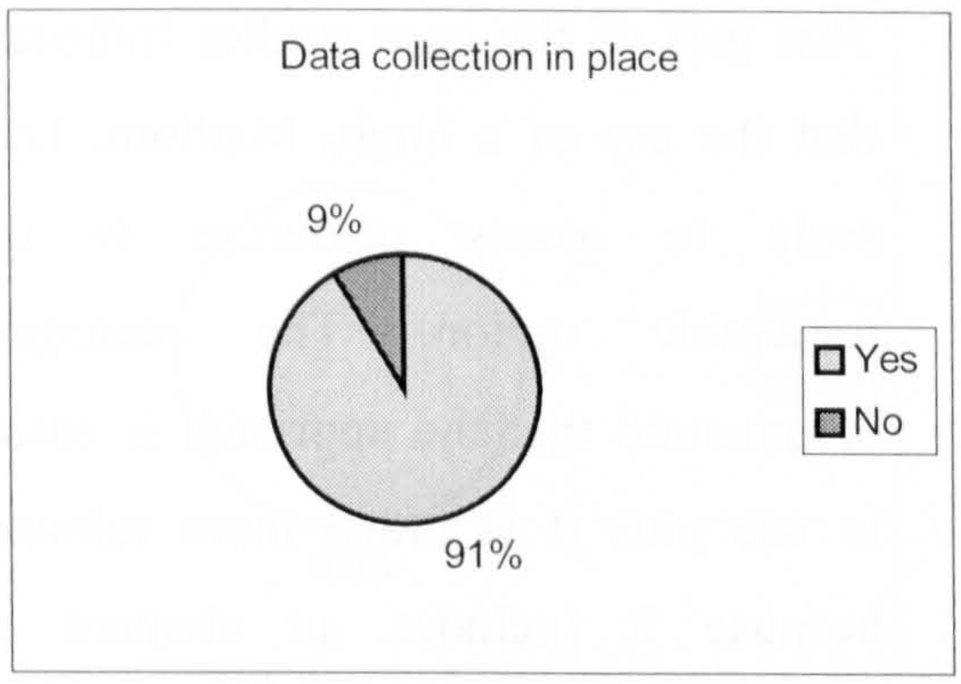




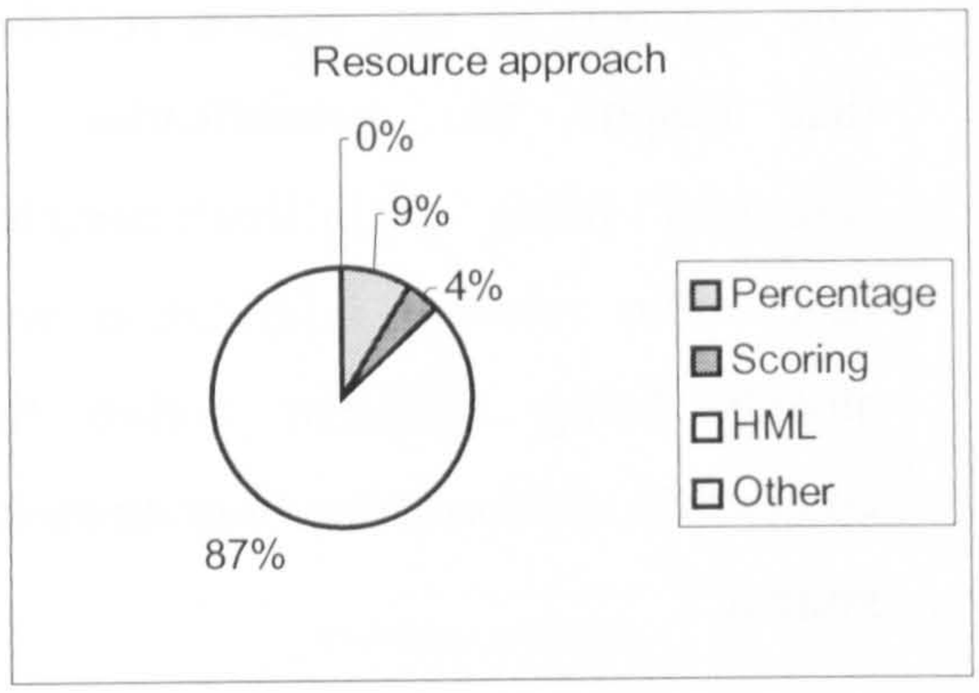


This part of the research confirmed that resources are considered during performance improvement but this is largely done informally. In the cases where there is formal assessment of resources this is mainly done in financial terms thus confirming the literature findings regarding performance measurement. The managers who stated that resources are formally considered were in their majority from financial functions.

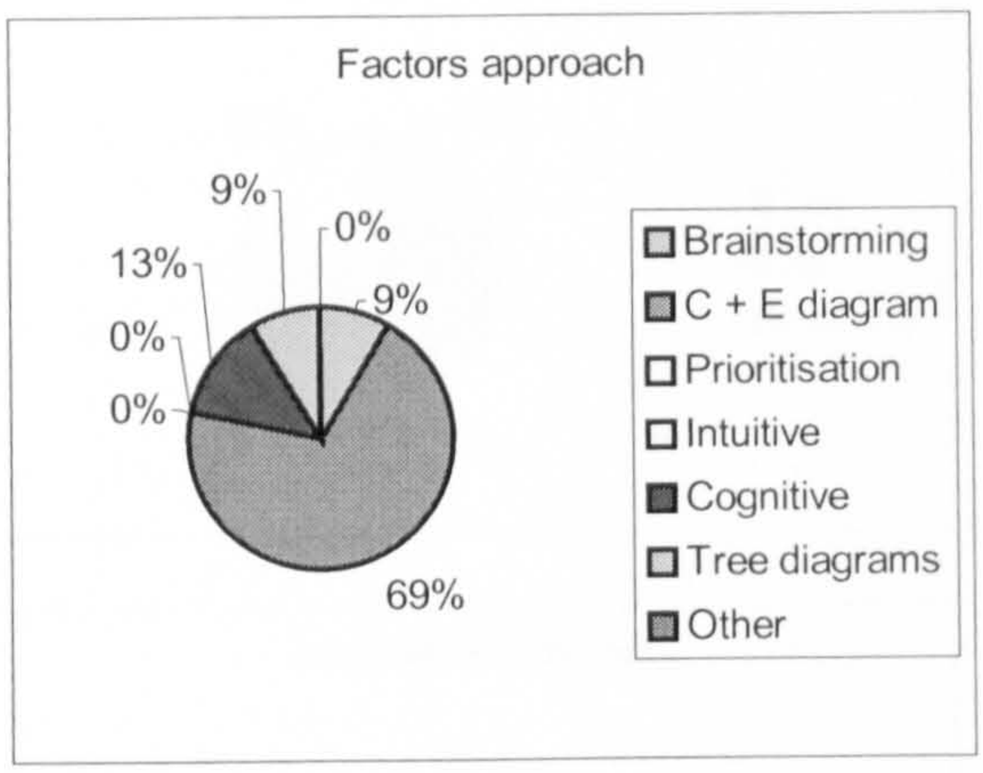
It is interesting to note that almost two thirds of the managers commented that the exact quantification of resources would not be feasible in their business context and thought it would be a complex task. To this end almost eighty percent of the managers commented that the information needed for such a task would not be easy to collect and thus further raising the usability of such an approach. This also confirmed the findings of earlier work done regarding performance interrelationship analysis, which was mentioned in Chapter 4. This last part set the foundation for investigating alternative collection methods for the performance improvement framework needs.



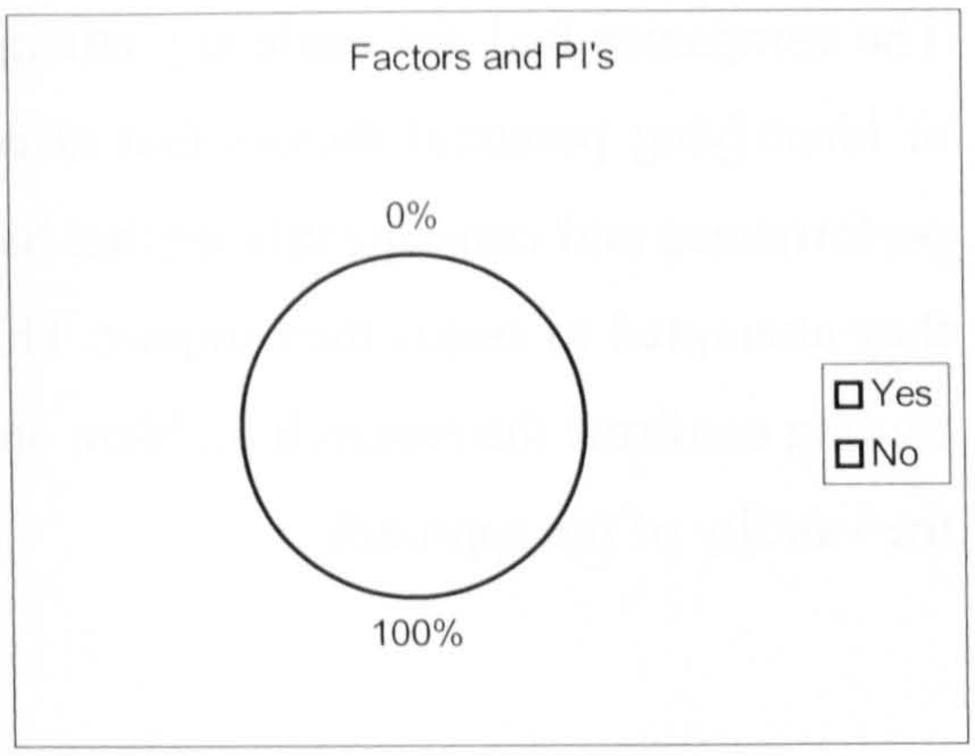
The last part of this section revealed that despite the quantification of resources being a difficult/complex task, other relevant information was already being collected within the company's performance measurement system.

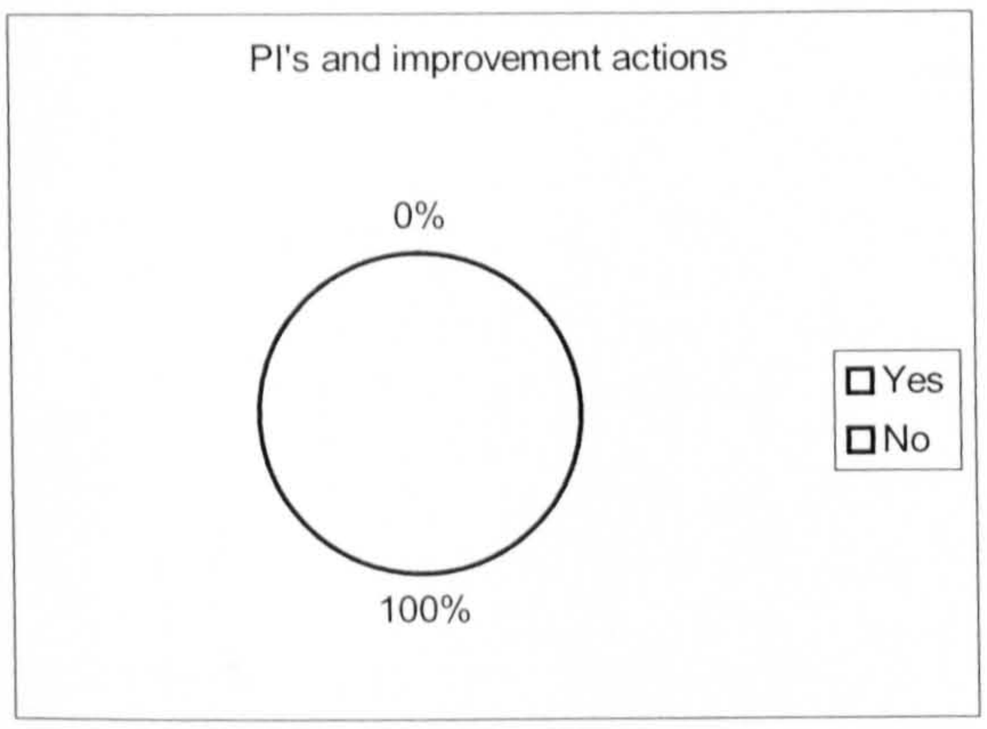


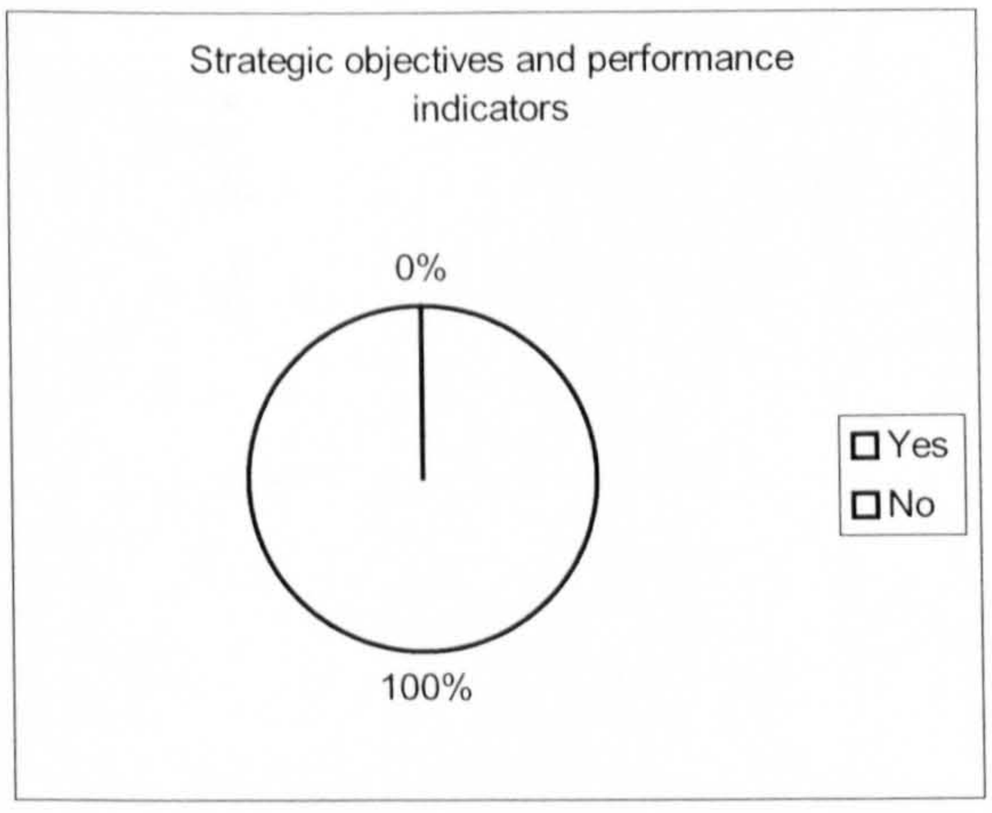
This part of the case studies indicated that the use of a High, Medium, Low scale to assess resources is the preferable option. The managers commented that the approach is easier to use plus it is much more relevant because it includes an element of comparison in it. The managers also commented that for every given company High, Medium and Low might mean different things but the scale can still be applied.



Regarding the identification of factors the managers were given a choice of documented techniques that have been used in literature to identify factorial problems. The majority indicated that the cause and effect diagram is the preferred option, not only because it is easy to understand but also because it includes an element of prioritisation of the factors.

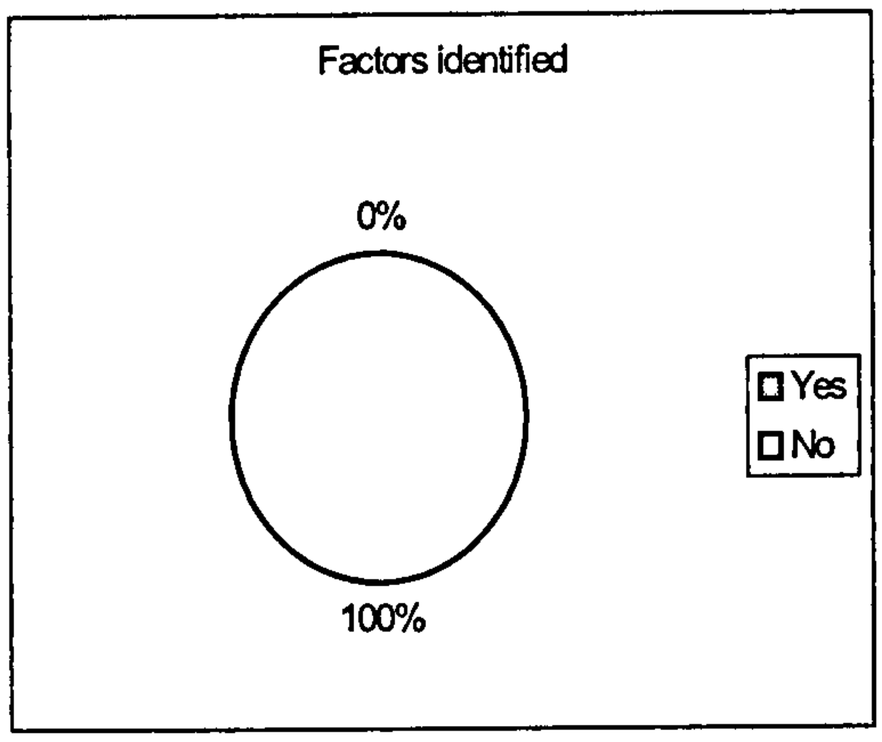


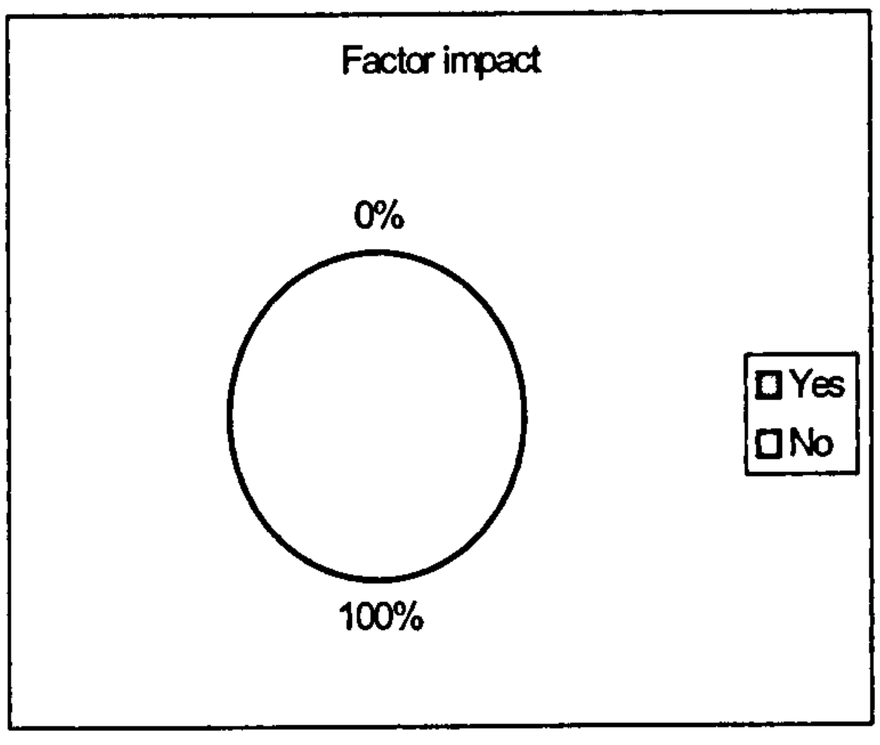




The results from this section of the case studies are more related to the companies' attitude towards causality and the research problem. The companies had not identified in any way any relationships between performance indicators and factors of performance and the same applied on potential improvement actions and factors of performance. A number of managers commented that the link between a performance indicator and an improvement action is only considered when action is taken and applies only to that specific indicator.

The companies were very clear about the links between their strategic objectives and the performance indicators they are using, and that reflects on the PMS design methodology they used which explicitly derives performance indicators form business objectives as identified in 'good' design guidelines in Chapter 2.





The companies had not made any attempt at identifying potential factors that affect performance and consequently neither had they attempted to assess their impact. This finding confirms the research problem and the validity of the approach.