CRANFIELD UNIVERSITY

MALCOLM YOUNG

Configuring In High Velocity Error Sensitive Circumstances: A Grounded Study

SCHOOL OF MANAGEMENT

PhD Thesis

CRANFIELD UNIVERSITY

SCHOOL OF MANAGEMENT

PhD THESIS

Academic Year 2005-2006

MALCOLM YOUNG

**Configuring in High Velocity Error Sensitive Circumstances:
A Grounded Study**

**Supervisor:
Dr David Partington**

December 2005

**This thesis is submitted in partial fulfilment of the requirements for
the Degree of Doctor of Philosophy**

ABSTRACT

The operational reliability of organizations that deal on a routine basis with very dynamic circumstances has been a rich domain of study for organizational scholars for many years. Increasing reliance on the application of complex technologies and human processes in a range of social endeavour provokes our need to understand the attributes of such processes. Traditional contingency theoretic perspectives tend to produce archetypal resolutions that identify in rather specific terms what organizational forms can be matched with particular environmental characteristics. But as the organizational environment becomes more dynamic this approach seems less credible. This research therefore moves beyond the search for archetypes to investigate the processes by which resources are configured in order to deal with dynamic circumstances. Further, with self-managed teams increasingly acknowledged to be central to performance, contributing to fast, flexible and creative action and therefore used as the fundamental work group, this study focuses on the meso-level of the team. This helps to limit the scope of the research task while still offering opportunities for good theoretical and practical contribution. Adopting a grounded, qualitative methodology it triangulates evidence from three dissimilar domains (accident and emergency, air traffic control and fire service) that share a common context of unpredictability, high velocity and error sensitivity. The findings identify a specific type of situated behaviour, termed agile configuration, by which team members configure remarkably flexible and reliable behaviours in very dynamic situations, suggesting an almost limitless range of potential configuring behaviours that avoid the limitations of configurational archetypes. The adduced models and explanations provide theoretical insights that increase understanding of behaviour in extreme contingencies and therefore advance traditional contingency theoretic perspectives, with particular relevance for concepts of dynamic capability. These outcomes also have practical potential for the development of agile configuration competence in self managed teams and larger organizational groupings.

ACKNOWLEDGEMENTS

Some years ago, a male Oscar winner, took his prize from the hands of another Hollywood luminary and to the surprise of the audience said that it was all his, worked for and won - nobody else's. He then proceeded to make a disarmingly grateful acknowledgement of all who had infact helped him. I now have the great pleasure to acknowledge the people who have been unstinting with their guidance and help in an endeavour that, although the very nature of a PhD Thesis dictates must be largely all mine, worked for and won - nobody else's, would have proven impossible alone.

I begin with my colleagues in the Class of 99. Many of the inky fingered swots have already completed and have basked in the warm glow of achievement for some time. Their friendship, empathy and comradeship have been much appreciated, and I am delighted finally to have joined them. Next, my thanks to all the administration and support staff, especially Barbara, Denise and Wendy in the Research Office who have always been ready with either sympathy or advice - and somewhat scarily always known which was required and when, ably led by Colin Pilbeam of course.

My first supervisor, David Tranfield, was immensely supportive and almost clairvoyant in his ability to see that there was something of value cunningly camouflaged by my incoherent initial ramblings. We parted as his university duties became ever more demanding rather than because of any intellectual divergence. I will always be grateful for his support and confidence when the way ahead seemed bleak. I must also thank my review panel of Alan Harrison and Alex Kouzmin who steered me around some of the less obvious theoretical and methodological pitfalls along the way.

For most of my studies good fortune has smiled on me in the shape of David Partington as my supervisor. David is a tower of strength, has real enthusiasm for research and for researchers and is a fount of knowledge especially with methodology. There were numerous occasions when his gentle but firm and persuasive advice revealed new possibilities for progress and much of the credit for my achievement must ultimately rest with him. I will always be particularly grateful to David for his calm and compassionate counsel during my wife's fight with cancer, which somewhat delayed the completion of my work. Thank you, David.

My son, Stephen, had the good sense and intellect to complete his PhD (in solid state electronics) early in his life, which somewhat reversed the usual order of achievement between a father and son. But his example and encouragement gave the spur to my own efforts, albeit now well gifted in years and duller of brain.

And so finally to my wife, Pip. Not only is she a wonderful person who has willingly supported me through my work and studies for many years but also she has steadfastly fought her own illness, now thankfully clear after nearly two years of surgery and therapy. She has been an inspiration and a soul-mate and it is with the greatest affection and pride that I am delighted, finally, to be able to say that – this one is for you Pip!

CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1   Rationale and aims for the research

1.1.1   Origins of interest

In the preface to her book *Organization Theory*, Hatch (1997b) suggests that narratives depend on the perspective of their authors. I have therefore chosen to begin with a short description of my background, which will serve to establish my personal perspective and provide context and rationale with regard to this study.

I initially spent 30 years in the British Armed Forces during which I was on many occasions involved in combat operations with increasing responsibilities up to unit commander level. In addition to my direct operational experiences I was also responsible for combat training as an instructor, training scenarios as a designer of combat simulations, and policy as an operational training branch chief at defence ministry level.

Throughout this extended period in what were superficially firmly hierarchical and highly centralized organizations I was struck by the extent to which people, at all levels of the hierarchy and in both training and operational environments, were expected and able to act in autonomous and creative ways. This facility was not confined to individuals. It was often evident that teams and indeed whole units would be able to configure their human and material resources in ways that were highly contingent.

For one example, in 1965 while serving in the Army on special operations against insurgents in Borneo, during contacts with enemy patrols it was the largely unpredictable features of the situation (comparative size of forces, dispositions, type of terrain, speed of enemy reaction, instantaneous use of weapons etc) that guided the outcome rather than conformity to some preset drill. Indeed, drills were largely seen as training artificialities rather than useful as operational enablers.

Subsequently as a ground attack and reconnaissance pilot in the RAF, mission success depended on interpretation of instantaneous factors rather than the precepts of training. Thus in 1972 during the Dhofar War in Oman, delivering air to ground rockets in level flight below a 300ft cloud base assisted in the relief of a beleaguered hamlet. This technique, though successful, was severely at odds with received tactical wisdom and the majority of normal flight safety considerations.

On leaving the Armed Forces, I became a director of a company delivering business development consultancy and support services. Again, it was obvious that the most successful organizations had an almost innate ability to adopt configurations that aligned with the instantaneous demands of their environments, in sometimes only fleeting manifestations. As with my military experiences, these tended to be contingent reconfigurations, sometimes recognizable as variations from some more established configuration and purpose, but always more attentive to characteristics of the prevailing

situation than to antecedents. One client company went from making precision pressed mouldings to extracting juice from oranges, as a downturn in demand for mouldings coincided with a glut of oranges, all in one week. They returned to precision mouldings with equal dispatch when the orange glut abated and a nearby motor factory expanded its production.

All these experiences while evident remained largely unexplained but are well captured by Schon (1983) when he suggests that we can all recognize phenomena for which we cannot give a reasonably accurate or complete description, make judgments for which we cannot state adequate criteria and display behaviours for which we cannot state rules and procedures. His point is to emphasize the utility of reflective practice, and has been a spur to this study.

A few years later, when established in the academic world, I was attracted to research this beguiling phenomenon because what were observable responses seemed to be inadequately articulated in theory or in guidance for practice. Also the literature indicated that, in an age beset by the challenges of technological advance and increasingly turbulent environments, academic and practitioner interest in the relationship between organizational environment, configuration and performance was increasing rather than abating (Bourgeois and Eisenhardt, 1988). Further, although current knowledge was set against a rich tradition of organizational studies (see Donaldson, 2001), it seemed to have at its core an interesting opportunity to challenge and extend some of our best-researched and authoritative organization theory. I was particularly intrigued that while current concepts derive from a trajectory that has moved from classical to contingency based theory, they still seek to identify stable archetypal configurations, given that different environments suggest different configurations (Burns and Stalker, 1962), rather than configuring mechanisms or processes. This trajectory is summarized below.

1.1.2   The trajectory of configurational research

Throughout the late 19th and early 20th centuries the ruling concept of organizational configuration was based on structures with enduring characteristics, universally referred to as classical theory. Leading classical theorists include Fayol (1949), Taylor (1947), and Urwick (1947) who, despite differences of detail between their individual perspectives, tended to promote a one-size-fits-all resolution (Buchanan and Huczynski, 1997).

Subsequently, researchers such as Burns and Stalker (1961), Lawrence and Lorsch (1967) Miles and Snow (1978) and Woodward (1965) identified a range of differing environmental characteristics that might influence organizational configurations. These supported a new general perspective that if environments could have identifiably different characteristics then it was unlikely that any single configuration of organizational characteristics would suit all environments (Thompson and McHugh, 1995).

The effect of these endeavours was to support the general proposition, voiced by Galbraith (1977), that there is no one best way of organizing and that any single way of

organizing will not be equally effective in dissimilar environments, or even in dissimilar circumstances in substantially the same environment. Rather, a contingency approach was required that matched configuration to circumstances.

Taking up this theme, more recently still researchers have extended the basic contingency approach to investigate, *inter alia*, the instrumentality of multiple structures in a single organization (Bigley and Roberts, 2001), the variety of ways in which different structures can be combined (Gibson and Birkinshaw, 2004) and the ability to move more or less rapidly between structural archetypes (Moon *et al*, 2004), in what seem to constitute what I shall call a neo-contingency turn. These hint at the potential for fundamental changes to established notions of contingency although they seem to focus on simple extensions of largely traditional concepts.

Although this more recent trajectory of research involves investigation of increasingly ambiguous, uncertain and unpredictable contingencies that are also dynamic and error sensitive, the outputs continue to identify variations of stable archetypes. But some scholars see these as variously decreasingly representative (Wilcox-King and Ranft, 2001), too limited in their scope (Brown and Eisenhardt, 1997) and therefore less theoretically convincing (Whetten, 1989). Also, in introducing their edge of chaos concepts, Brown and Eisenhardt (1997) suggest that there are many more contingent influences than previously envisaged for which a limited repertoire of archetypal configurations holds little meaning.

Central to all these and similar arguments are the related notions, identified by Francis (1991), that configuration is contingent on aspects of the organizational environment and that the rate of environmental change is becoming a, if not the, crucial contingent factor in determining the processes of configuration.

At the heart of the ebb and flow in these and similar debates, as Reed (1991) had already identified, there nestles a state of intellectual flux and uncertainty that, while it remains, provides fertile ground for further investigation. It follows, as Thompson and McHugh (1995) propose, that it is by revisiting some of the issues in these areas that we can find new opportunities for contribution. I therefore surmized that a logical extension to this general trajectory would be to investigate environments where the velocity and error sensitivity of unpredictable contingencies were extreme and to reveal the configuring processes in use. In the context of this research, contingency implies dependence on chance and therefore not predictable, velocity refers to the rate of occurrence and error sensitivity to how sensitive the domain is to migration of error.

A further consideration is that a good deal of the extant research in contingency topics cited above tends to focus on the macro-level of the whole organization. Alternative approaches, found in the psychology and social psychology canons (see for example: Carpenter and Golden, 1997; Finkelstein and Hambrick, 1990; Hambrick and Finkelstein, 1987) tend to favour the micro-level of individual executive decision making. However, scholars such as Ginnett (1988), Hutchins (1991, 2000), Weick and Roberts (1993) have found it useful to investigate at the meso-level of the work-group or team. This helps to limit the scope of the research task while still offering opportunities for good theoretical and practical contribution (Whetten, 1989, 2000), but

3

also has a broader significance. Gordon (1992) notes that teams are increasingly the fundamental work group, a view reflected by Katzenbach and Smith (1993) who suggest that they are becoming central to performance, with the self managed work team identified by Cohen *et al* (1996) contributing to the fast, flexible and creative responses denied to whole organizations (Lipman-Blumen and Leavitt, 1999), especially when they are large.

My purpose is therefore to investigate how teams configure responses to extreme contingencies, characterized by unpredictability, high velocity and error sensitivity. I have used the related terms configure as action and configuration as condition thus far, and continue throughout the thesis, to connote the dynamic arrangements that are increasingly used in unpredictable, high velocity and error sensitive situations (Oliver and Roos, 2003). These terms also allow for cognitive, behavioural and material resources to be included in what is a processual perspective, and serve also to differentiate my concept from the more static structural archetypes of mainstream classical and contingency theory.

The inspiration for undertaking this research comes from a number of general observations made by leading scholars. Glaser and Strauss (1967), subsequently echoed by Burrell and Morgan (1979), Eisenhardt (1989) and Mintzberg (1979) among others, suggest that modern sociology is too concerned with theory testing rather than with theory building. Marchington (2000) identified the contribution that more contextually rich descriptions could make as counterpoint to the dominant variance testing models. Jointly and severally, these scholars propose that, rather than being limited by rational, incremental development, our insights should allow more complex concepts to emerge. This search for new insights implies a qualitative, theory building approach (Bryman and Bell, 2003; Johnson and Harris, 2002).

1.1.3 Using a theory building approach

The value of a qualitative, theory building approach is most evident when researching in a field for which little or no formal theory exists or, as here, when new insights are sought (Bryman and Bell, 2003). Identifying a real strength at the core of the approach, Johnson and Harris (2001) suggest that the qualitative/inductive approach is capable of answering not only the original research question but also of answering questions not originally asked. They propose that when a researcher remains open to surprise rather than remaining devoted to initial expectations, ever more interesting insights can emerge from fieldwork.

When seeking new insights it is also best for the research to be conducted from the perspective of the informant. This requires considerable engagement with the informant's domain, so that it captures concepts and categories used by the informants to organize their world and therefore aids the emergence of surprising insights (Jones, 1985, 1987).

For this process to remain as open as is possible the exploratory approach known as grounded theory (Glaser and Strauss, 1967) in particular allows for unexpected patterns to emerge from the data. With origins in symbolic interactionism (Blumer, 1969), the

grounded approach seeks to reveal how the intelligent intentions of organizational actors mediate responses to environmental stimuli. This is explained in more detail in Chapter 3 but it is helpful here to note that the outputs of grounded research are deemed as warranted because they are generally recognized: to 'fit' the data, in that their attributes match the realities under investigation; to 'work', in that they explain the behaviour within and across research domains; to be recognized by and relevant to the informants, and; to be readily modifiable as a result of further research. This approach also aligns with my personal perspective on organizational research as the production of practical knowledge as well as good theory.

1.1.4   A personal perspective on organizational research

I believe that how knowledge is used is at least as important as how it is derived. I begin from the assumption that the purpose of organizational research is to contribute to and therefore to extend organizational knowledge, which presents an immediate challenge: to identify how knowledge should itself be organized. The two most obvious candidate options are in the form of theory and in the alternate form of method. These are neither alien nor mutually exclusive concepts. Each piece of published research explicates the methods used in testing or developing the espoused theory.

Proposing that knowledge might better be organized as method, Umpleby (2002) notes that while theoretical statements describe what we think we know, methodological statements describe how we act in order to develop, test or use that knowledge. By analogy, he extends his concept of research to the practice of managing more generally, proposing that knowledge in the field of management should be organized in the form of methods rather than theories, replacing strict hypotheticals (if A then B, ceteris paribus) with more general injunctions (if you want these kinds of results then act in this kind of way).

This is similar to van Aken's (2004) notion of management research in the paradigm of design science. He proposes that management research should seek to solve practical problems; offering grounded and tested technological rules that will guide practitioners. Developing a similar theme in an argument that integrates theory and practice without conflation, Tranfield *et al.* (2002), conceptualize knowledge simply as the capacity to act.

In a seminal work, Gibbons *et al*, (1994) identified the dominant approach to research as Mode 1, which represents the relative isolation of university based, single discipline research that produces theory. They argue for a new approach, Mode 2, which represents transdisciplinary research undertaken in the context of application, that is to say practice. Whether options that integrate these modes are best expressed as Mode 1½ (Huff, 2000) or by any other nomenclature, it is clearly of increasing concern to the academy that outputs should be relevant to management practice, a view exemplified by the formation in UK of the Advanced Institute of Management in 2002, and most recently supported by Bennis and O'Toole (2005).

Much derives from Hambrick's Presidential Address to the Academy of Management, (Hambrick, 1994) in which he urged that management researchers take responsibility

for improving the institutions they study, by entering the world of practical affairs and striving for influence and impact. He cites an obligation to provide not only rigorous analysis of data to contribute to theory but also suggestions for practice to improve the systems under study. Similarly, Tranfield and Starkey (1998) argue that much management research has lost touch with the concerns and interests of practitioners and that management and business researchers must relearn how to be responsive to them in order for their research to retain a value and a purpose. Continuing the same theme, Starkey and Madan (2001) hold that if research, and thus the mandate to create knowledge, becomes separated from the needs of stakeholders and fund-providers because it is perceived as not relevant, then it raises critical issues of justification and, ultimately, long-term survival of management research.

This range of independent yet similar thought reflects a number of aspects of my own general philosophy for organizational research; that it has an essentially practical purpose. My perspective is found on the initial contention, voiced by Umpleby (2002), that it is but a short and legitimate move from the theory/method argument for organizing knowledge to a theory/practice argument for the outputs of research. Accordingly, we can say that whereas organizing as theory describes what is known about organizations, organizing as practice describes how managers act, more or less knowledgably. This conceptual separation illustrates Pettigrew's (1995) double hurdle for management research: the first to meet scholarly criteria for rigour by being embedded within the social sciences, and the second to be relevant to managers by being embedded in the worlds of policy and practice.

Clearly these concepts are not incommensurable, but it is useful to at least acknowledge their discrete concerns. However, I suggest that we need to go a stage further since even being relevant does not ensure that research outputs are taken into practice.

Some years prior to the current conversations, Pelz (1978) characterized knowledge as conceptual (that which increases understanding) and instrumental (that which facilitates action). Explicating their own perspective on research outputs, Beyer and Trice (1982) chose to characterize knowledge as adopted (that which informs concepts) and implemented (that which informs specific practices). More recently, van Aken (2001) combined these insights to voice his concern that the fruits of our research should be instrumental and implemented rather than simply conceptual and adopted.

However, he argues that for this to become reality we need to provide guidance as to how managers *should* act, given certain contingent influences; this seems to perpetuate the search for delimited, normative repertoires of archetypal configurations. My view is that we should identify warranted heuristic guidance as to process rather than prescriptions and that configurations should therefore be emergent rather than normative. It is this broad philosophy that guides my research interests and approach and sets the tone for the remainder of the thesis.

1.2   Research process

1.2.1   Summary of research design and methods

As a natural progression from my preceding arguments, in this programme of research I focused on a single context, that of unpredictable, high velocity and error sensitive environments. Following Pettigrew (1974), I believed that these extreme characteristics offered increased opportunity for interesting and new insights to emerge. Within this general context, I selected three dissimilar domains in which teams routinely experience these contextual characteristics. Following Gardner (1997) in understanding a domain as an area of human practice valued by society and mastered through a recognized apprenticeship, the three selected domains were a trauma team in an accident and emergency unit, a controller team in an air traffic control centre and a watch in a fire and crash rescue station. As a guiding concept I decided that selecting three dissimilar domains offered the opportunity to identify processes that were domain specific and/or stable across domains.

I kept the initial research question broad so as neither initially to exclude nor subsequently to compromise the emergence of interesting and unexpected insights, and expressed it as:

> 'How do teams configure for unpredictable, high velocity, error sensitive contingencies?'

The unit of analysis derived logically from the research question as 'the process of configuring at the team-level'.

In order to elicit in depth attributes derived from the experience and therefore the perspective of informants within three dissimilar domains, I based the research design on case study (Harrison, 2001, Hartley, 1994). Case studies have an important function in theory building especially, as in this research, when investigating emergent organizational behaviour that might be informal or unusual, when current theory is weak or under-developed and there are potentially many variables whose connections might not be immediately obvious (Hartley, 1994).

The framework for data collection, analysis and theory development was that of grounded theory (Glaser and Strauss, 1967) in which theory emerges from data in a logical manner. In order to capture the experience and therefore the perspective of informants the dominant data collection method was interviews with key informants in each domain. The interviews were recorded and transcribed to facilitate in depth analysis away from the research domain. Some observation was also used. However this was limited to personal orientation within the domains and to provide background for interviews rather than as a basis for ethnographic speculation.

The data was analysed using the two central processes of grounded theory, namely theoretical sampling and constant comparison. According to Glaser (1992) theoretical sampling entails that the data collection strategy and schedule is dictated by the emerging theory rather than by predefinition. Constant comparison involves comparing

and coding instances of data with other instances in order to develop semi-stable categories. As the data collection and analysis progress, this comparison becomes between new data and categories of the emerging theory until the theory is saturated, that is when no new categories or significant revisions emerge.

This approach ensures, insofar as is possible that the theory meets the four criteria mentioned earlier, that the theory should fit the data, that it should work, that it should be relevant and that it should be modifiable.

The research approach is developed in considerable detail in the body of the thesis but it is pertinent here to note that I employed a parsimonious model (Partington, 2001) that was useful in retaining focus in what was intentionally a loosely structured methodology. The model has four core elements: purpose, research question, theoretical perspective and research design. Partington (2001) proposes that these need explicit attention and should be kept in a dynamic balance throughout the research. The model provides a useful conclusion to this section.

Purpose. Accepting that a clear purpose is essential in any research project I described this as: 'to explain in a way that informs both theory and practice the processes by which teams that routinely encounter unpredictable, high velocity and error sensitive circumstances configure their responses'.

Research question. Adopting a processual rather than an archetypal approach the research question was therefore: 'how do teams configure responses in unpredictable, high velocity and error sensitive circumstances?'

Theoretical perspective. As a theoretical perspective I adopted a conceptual hypothesis regarding the research process to aid design, data collection, analysis and theory construction but made no *a priori* assertions about the research topic or potential outcomes. I expressed this as: 'individual's concepts and meanings inform their social action/interaction, about which they can produce subjective accounts, from which the researcher can elicit social scientific descriptions of underlying mechanisms, which generate theory'.

Research design. Having chosen to investigate emergent organizational behaviour in an area where current theory is weak or under-developed, the research design was based on case study. Studying three cases in dissimilar domains offered the opportunity to triangulate findings.

1.2.2   Summary of research findings

It is a recognized and frequently criticized characteristic of grounded qualitative research that simple descriptions of the emergent theory are difficult to articulate (Bryman and Bell, 2003). For example, in the body of this thesis the theory emerges over many pages of data extracts, analysis and explanatory text that span four chapters. The findings also represent an explanation of how responses are configured rather than a crisp description of archetypal responses. Understanding these characteristics is important to a full appreciation of the findings.

However, the findings can be summarized in a three level model, of agile configuration as a discrete expression of situated behaviour, which in turn is theoretically connected to an initial symbolic interactionist perspective.

The initial general statement of findings identified and located components and attributes of a configuring mechanism in a mediating role between stimulus and response in a symbolic interactionist model (Blumer, 1969). However, to accommodate emergent non-cognitive attributes in the explication, the elements of this model were then re-integrated into a closely related model of situated behaviour (after Piaget, 1979 and Suchman, 1987), the better to express the dynamic configuring processes. Situated behaviour then provided the theoretical platform for a process identified as agile configuration.

Emerging from this theoretical platform, agile configuration is an expression of situated behaviour with four distinguishing behaviour traits. These comprise, focusing on a superordinate goal, having a bias for action, attending to unique rather than routine or superficial aspects of the situation and using the resources to hand. These guide instantaneous group interactions to configure contingent resolutions that work in context rather than accord with abstracted plans and procedures.

These findings and theoretical locations can be summarized as:

Teams working in domains characterised by unpredictability, high velocity and error sensitivity use agile configuration as their primary behaviour. Agile configuration is a discrete type of situated behaviour with four signature routines namely:

Focus on superordinate goal

Bias towards action

Attend to the unique aspects of the situation

Use the resources to hand

1.2.3   Structure of the thesis

To introduce and develop the arguments, summarized here, in detail, the thesis comprises eight chapters, including this introduction, that cover the literature in the field, methodological considerations, case narratives with theoretical comments, summary analysis and theoretical development and final conclusions. These are constituted as follows.

Chapter 1. Introduction.   In the introduction I summarize the whole of the research process, including the findings to set the scene for the more detailed explication that follows.

Chapter 2. Perspectives on organization and organizing.   I begin with a summary of approaches to the issue of organizational arrangements, in order to locate the research in an appropriate context, to identify the current trajectory of research, to articulate the aims and broad research questions and to propose opportunities for contribution. However, I avoid introducing literature from the substantive domains of research so as not to predetermine outcomes. Rather I introduce and discuss literature progressively through the thesis, as it seems to bear most directly on the emerging theory, either as complement or conflict.

Chapter 3. Methodology.   I explain how I arrived at my methodology, I acknowledge the external and internal influences on the methodological decisions I made, and reveal the sources of and the connections between the purpose of the research, the philosophical and theoretical perspectives I took and the research question. I explain in detail the research design and the methods that I employed and comment on issues of quality and rigour in qualitative research.

Chapter 4. Results from an accident and emergency department. I present the results from the first study domain - the Accident and Emergency (A&E) Department of a National Health Service (NHS) Trust Hospital in a descriptive narrative of the domain, from which I develop initial characteristics of configuring processes.

Chapter 5. Results from an air traffic control centre.   I present the results from the second domain of study – an Air Traffic Control Centre (ATCC) in a descriptive narrative. I include some observations on data collection and analysis in the light of the outcomes of the first study. I then analyze the data and identify how I used the outcomes to refine initial concepts adduced in Chapter 4. I conclude with some implications for the third study.

Chapter 6. Results from a fire crash rescue station.   I present results from the third domain of study, a Fire/Crash Rescue station within a regional Fire Service. I include further observations on data collection and analysis in the light of the outcomes of the first two studies and I distil the key examples of the data within an integrating narrative. In my analysis I justify the assertion that I have achieved theoretical saturation of the categories germane to the emerging theory.

Chapter 7. Summary analysis and theoretical development.   I integrate and triangulate the data and findings across the three research domains to reveal the configuring process within a symbolic interactionist framework. I then locate the central concept of agile configuration within an original model of situated behaviour, and make explicit the connection with the symbolic interactionist framework.

Chapter 8. Conclusions.   I locate specific contributions in the literatures on knowledge, situated action, coordination, routines, bricolage and improvization, and dynamic capability, with more general locations in contingency and high reliability. I identify the implications of the findings for organizational practice. I move to a critical analysis of the research and conclude by identifying opportunities for further research.

CHAPTER 2

PERSPECTIVES ON ORGANIZATION AND ORGANIZING

2.1   Integrating the literature with the research process

The scholarship element of any research endeavour requires that the researcher is able to demonstrate a comprehensive understanding of the field in which the research is located (Bryman and Bell, 2003). Scholars have variously expressed this but most explications acknowledge two important aspects. The first is accurately reporting the ideas of fellow scholars and how they bear on the work in hand in terms of what is already known (Gill and Johnson, 2002; Hart, 2001) and the second is speculation on what interesting developments can be discovered through further enquiry (Davis, 1971; Saunders *et al*, 2003); traditionally, this includes a critical review of what has been written on the topic of interest in order to reflect the current state of knowledge and to identify the area for contribution (Gill and Johnson, 2002). The fundamental intention of the literature review is therefore to summarize extant literature relating to the field under investigation in such a way that the researcher's understanding is evident from what must of necessity be a selective range of example.

However, given the wide spectrum of philosophical and methodological approaches to social enquiry that Blaikie (1995) identifies, each with their own internal logic and structure, it remains moot as to precisely how and when the review should be accomplished. Even so, two broad approaches are widely accepted in the academy. The first is that a comprehensive review should precede deductive studies to facilitate the formation of testable hypotheses (Saunders *et al* 2003); the second is that for inductive studies the progressive comparison of emerging data with the literature is recommended, to allow interesting theoretical insights to develop (Glaser and Strauss, 1967; Strauss and Corbin, 1998). In this latter regard, Glaser (1992) even suggests avoiding the literature in the substantive area of study completely until data has been collected. However, Parkhe (1993) points out that a clean theoretical slate is virtually impossible to achieve, and it also seems marginally perverse to suggest that meaningful research can be attempted without at least a competent knowledge of the subject area. The issue seems to be one of perception and degree, and therefore subjectively informed, rather than of absolutes and therefore objectively derived. Also, the depth and timing of review seems intimately connected to the methodology and methods in use.

As I have already noted in Chapter 1, and develop in more detail in Chapter 3, I opted to use a grounded, and therefore inductive, qualitative approach to this study. When using this approach, in general, and notwithstanding the need to be informed in one's field (Gill and Johnson, 2002), it is considered inappropriate to be too immersed in current thinking since this may unduly affect the emerging theory (Glaser, 1992). In consequence, I chose to introduce the literature in a measured way throughout both the research and the thesis. I begin with a summary of approaches to the issue of organizational arrangements, in order to locate the research in an appropriate context. I then draw on these antecedents to articulate the aims and broad research questions and to propose opportunities for contribution. In the body of the theses, as findings emerge from the analysis of data, I introduce and discuss literature progressively as it seems to

bear most directly on the emerging theory, either as complement or conflict. This includes complementary or challenging insights that emerged contemporaneously with this particular research project. Indeed, in what emerges as a burgeoning field of interest, several authors published influential studies while the research reported here was in progress, for example Bigley and Roberts (2001), Gibson and Birkinshaw (2004), Moon *et al* (2004) and Oliver and Roos (2003, 2005) whose contributions are acknowledged later.

The final use of the literature in this study is to identify summative locations for theoretical contribution, but I begin with a summary of antecedent contributions.

2.2   Some perspectives on organization and organizing

It seems that from earliest times mankind has made various attempts at organization. As soon as a task was seen to require more than one person to achieve its goal then some form of what we now refer to as organization, however rudimentary, intervened (George, 1972). Also, from arranging the defence of a Neolithic hamlet to the spread of an empire, from the supervision of a small group of hunter-gatherers to the control of a trans-national corporation, performance is seen to be a function of, if not precisely synonymous with, organizational form (Buchanan and Huczynski, 1997; Donaldson, 2001). As an early illustration Morgan (1997) cites Frederick the Great, who initiated the separation of previously conflated staff and line specialisms in seeking to improve both the effectiveness and the efficiency of the 18th Century army of Prussia.

However, as Drucker (1995) observes, organization as sociological terminology and therefore as a focus of scholarly study, is a comparatively recent phenomenon only revealing itself in the very late 19th Century. As to what an organization is, the broadly accepted concepts of collectivity and goal focus are captured by Buchanan and Huczynski (1997) as a social arrangement for achieving controlled performance in pursuit of collective goals. Similarly, Hatch (1997b) notes that organizing usually involves activities that are too large for individuals to perform unassisted and most often represent a pooling of skills, knowledge and other resources.

Furthermore, for at least as long as scholarly interest has been focused on problems of organization it has been held that there is a connection between the characteristics of the environment in which an organization exists and the form or structure that it adopts in order to exist successfully in that environment (see for example: Etzioni, 1975; Graham, 1987). What has remained as an abundant source of debate among theoreticians and practitioners is precisely in what that connection consists. Proposals have varied from single, supposedly universally applicable to more flexible relationships and have invoked notions ranging from Weberian rational design (Mintzberg, 1979) to Darwinian natural evolution (Byrne, 1998). Variously named, the options tend to be allocated to categories that align with so-called classical and contingency theoretical perspectives.

Leading classical theorists include Fayol (1949), Taylor (1947), and Urwick (1947) who, despite differences of detail between their individual perspectives, promoted a one-size-fits-all resolution. While this may have had some relevance in the less

turbulent organizational environments of the time, after and perhaps as a direct result of the Second World War new perspectives began to emerge.

Researchers such as Burns and Stalker (1961), Lawrence and Lorsch (1967), Miles and Snow (1978) and Woodward (1965) identified a range of differing environmental characteristics and influences, establishing the notion that if environments could have identifiably different characteristics, then it was unlikely that any single configuration of organizational characteristics would suit all environments (Thompson and McHugh (1995). These endeavours gave support to the general proposition (Galbraith, 1977) that there is no one best way of organizing and, as corollary, that any single way of organizing will not be equally effective in dissimilar environments, or even in dissimilar circumstances in substantially the same environment. This perspective held that organizational configuration was therefore contingent on environmental influences, which gave rise to the contingency perspective.

More recently still researchers have extended the contingency approach to investigate, a range of phenomena that includes: the instrumentality of multiple structures in a single organization (Bigley and Roberts, 2001); the variety of ways in which different structures can be combined to meet contingencies (Gibson and Birkinshaw, 2004); the ability to move more or less rapidly between structural archetypes (Moon *et al*, 2004), and; edge of chaos concepts (Brown and Eisenhardt, 1997), in what increasingly seem to constitute a neo-contingency turn. I suggest this turn because these new insights are tending towards fundamental changes in established notions of contingency rather than simply extending traditional concepts.

In the general trajectory from the relative stability of the classical perspective through the continuous development of new insights in the contingency perspective we can detect an increasing interest in more ambiguous, uncertain and unpredictable contingencies that are also dynamic and error sensitive. However, the outputs still tend to identify limited repertoires of what continue to be portrayed as essentially stable archetypes. But as Wilcox-King and Ranft (2001) observe, these environments stable configurational archetypes seem unrepresentative and therefore less theoretically convincing. Also, in introducing their edge of chaos concepts, Brown and Eisenhardt (1997) suggest that there are many more contingent influences than previously envisaged. They suggest that under these influences attempts to identify delimited ranges of archetypal configurations hold little meaning and that more dynamic concepts are needed.

Clearly evident in all these and similar arguments is the notion that configuration is contingent on identifiable aspects of the organizational environment. Thus size (Child, 1972) or technology (Woodward, 1965) might have significant influence on organizational configuration. But in an interesting theoretical insight developed from Burns and Stalker (1961) and Woodward (1965), Francis (1991) accepts their general notion of contingency but proposes that implicit in their argument is that the rate of environmental change is becoming the crucial contingent factor in determining the process of configuration. He couples this with Galbraith's assertion (1977) that uncertainty is the core concept behind organizational configuration to propose that

uncertainty and rate of change are more influential configurational concerns than are size, technology, etc.

While it may be a bit strong to portray this as essentially an either or situation, I would certainly agree that research into configuring processes rather than configurations themselves holds the prospect of real contribution in the context of increasingly uncertain and dynamic organizational environments. In this I take up another insight from Francis (1991), when he suggests that the key contribution of contingency theory is not as a predictor of configurational features for particular environmental attributes rather it is as a conceptual, analytical framework for how those configurations emerge.

This research was inspired not only by these new research possibilities but also by an astute observation made by Glaser and Strauss (1967), subsequently echoed by Burrell and Morgan (1979), Eisenhardt (1989), Mintzberg (1979) among others, who have jointly and severally proposed that modern sociology is too concerned with confirmation of current theories rather than generation of new theories.

Even having chosen to follow the neo-contingency turn, and to seek new insights rather than to revisit more traditional perspectives, it remains important to review the history of structuring in organizations to develop a more detailed trajectory of knowledge claims. I found it useful to focus my review on the classical, contingency and neo-contingency views previously adduced. I wanted to understand the developments in theoretical perspectives and to identify how they might inform my research, through the identification of opportunities for contribution. I began with the classical perspective.

2.2.1 The classical perspective

Introducing the classical view is neither solely a historically contextual device nor is it simply a page-filler. The classical perspective represents a significant contribution in early attempts to understand organizational structure and management processes and to provide a system for analysis (Pugh and Hickson, 1996). But, somewhat paradoxically, it also provides an early insight into the notion of contingency to which I return below.

Fundamentally, the classical era, which covers the latter part of the nineteenth and the first third of the twentieth century, was most notable for the search for a single best way of organizing (Hanna, 1988; Buchanan and Huczynski, 1997; Hatch, 1997b), in other words an idealized representation or 'ideal type'. Ideal types derive from the influential work of Weber (1947), who originated the bureaucracy concept that focuses on formal expressions of rules and procedures, defined divisions of labour and an authoritative hierarchy.

However, as Morgan (1997) explains, nowhere in all Weber's work is the notion of ideal type intended to be a literal and therefore singular prescription. Weber (1947) introduced it solely as a methodological tool, a concept against which empirical findings could be compared. He accepted that an ideal type might not be found in pure form although he maintained that it should be objectively possible; in this he intended that no characteristic of an ideal type should prevent it from existing. In his conceptualisation,

ideal types are also corrigible, with their particulars changing as theory and experience advance.

Nonetheless, examples of idealization as normative invocations can be found in the principles of management and administration espoused by Barnard (1938), Fayol (1949), and Urwick (1947) for whom organizing meant building a structure of resources with detailed task plans and precise managerial responsibilities for their application. Indeed, Urwick's general thesis was that there were identifiable principles of organization that should govern social arrangements of any kind (1947). Similarly, Taylor (1947) in his concepts of scientific management held that the micro-division of labour matched to precisely defined tasks would release best economic value for both employers and employees.

These are highly formalized (idealized) functional perspectives that entail either standardization or direct supervision as what Mintzberg (1979) subsequently identified to be coordinating mechanisms. Further, these idealized approaches seem to depend for their efficacy on the presumption of a stable, or at least predictably dynamic environment, since only under these circumstances is reasonable prediction possible (Byrne 1998).

So it was that during this early period, building on the sociological insights of Durkheim (1982), Marx (1975) and Weber (1947), that Fayol (1949), Urwick (1947) and others began to recommend single and universal law-like solutions to the problems of organizing in what has become known as classical theory. Baker (1972) observes that the use of the word *classical* in this context is intended to combine concepts of simple principles and general application with architectural notions of formality and rigidity. It is also notable that these and similar early contributions are explications inducted from the work experience of the authors, much in the manner of the current 'Heathrow' literature, rather than from rigorous empirical research (Buchanan and Huczynski, 1997). Nonetheless, they were immediately influential and, as Hanna (1988) records, remained the most widely accepted organizational practices until the mid-20th Century.

Similar concepts were implicit in the sub-organizational-level, shop floor investigations of the scientific management school that, in addition to Taylor (1947), included Gantt (1919) and Gilbreth (1911). Their influence is jointly and severally evident in such present day activities as project management, the design of automotive production lines and, perhaps of most common experience, the regimentation of fast food outlets. All evidence suggests that these early concepts remain highly influential among practitioners, albeit perhaps less so among theoreticians.

These classical approaches were subsequently grouped together using what Morgan (1997) cites as a machine metaphor, reflecting the underlying assumption that an organization was a collection of parts that needed to be standardized and centrally controlled. In their earlier 'mechanistic' elaboration, Burns and Stalker (1961) had advocated that mechanistic forms could exist successfully under stable conditions that would allow for explicitly predictable ways of working using the precisely defined roles, duties and methods enshrined in strict bureaucratic principles. Essentially, these told workers what they must attend to and how, as well as what was not their affair and

15

posted elsewhere as the responsibility of others. Hanna (1988) identified some of the
signature issues that arose in five summary principles, shown in Figure 2.1, that exhibit
a logical and hierarchical relationship.

Tasks are specialized and reduced to the smallest possible work cycle

Work is performed the same way every time

Tasks are handled exclusively by those assigned to them with no duplication of effort

Consistency is achieved through uniform policies and procedures

Decision-making is exclusive to those in authority

Figure 2.1   Summary principles of the classical view (after Hanna, 1988)

Interestingly, and demonstrating a sensitivity to the complexities of the issue that is
often overlooked in interpretations of his work, Fayol (1949) also noted that we are
seldom able to apply precisely the same principle twice since seldom do we encounter
precisely the same conditions twice.   This is chronologically interesting because the
1949 publication was a translation of his original work, first published in 1895. It
therefore seems that the existence of absolute, universally applicable organizational
characteristics, and therefore the possibility of enduring prescriptive rules, was in
question even among influential writers early in the classical era.

As both experiential and more rigorous empirical investigations continued, the notion
that more flexible approaches might be both possible and appropriate began to emerge
in what has come to be elaborated in the contingency view.

2.2.2   The contingency view

Recently capturing an important and increasingly popular notion, Drucker (1995)
proposes that organization is a tool, a means to an end with no warrant beyond its
contextual utility. The implication here, as Gouldner (1954) found in his study of the
differences between surface and sub-surface work in a gypsum plant, is that different
ends call forth different means. Over time the realization has developed that, to be
successful, an organization needs to match itself to the environment in which it exists
and to the tasks in hand rather than to some idealized (sic) representation. In short, this
can be expressed as the concept that an organization needs to adapt its structure to the
contingencies of its situation (Donaldson, 1985).

This basic concept is echoed by Dawson (1996) who observes, of particular interest for
this study, that many researchers have become increasingly captivated by the idea that
one can credibly talk in terms of appropriate fits between the characteristics of the
organization and those of its environment. In the academic firmament of these debates,
Reed (1991) suggested that a state of intellectual flux and uncertainty could be
identified that, while it remained, would continue to provide fertile ground for further
scholarly investigation. Supporting this view Thompson and McHugh (1995) proposed
that revisiting some of the issues in these areas would encourage more radical and

perhaps more complex concepts to emerge with opportunities for contribution based on new insights rather than limited to rational, incremental development.

Donaldson (1985, 2001) suggests that at the heart of structural contingency theory lies a simple notion in three particulars: the structure of an organization is associated with the contingencies of its environment; the association is that contingencies in some way determine the structure, and; there is a fit between contingency and structure, sometimes referred to as congruence (Nadler and Tushman, 1997), which improves performance. Thus, structural contingency theory is guided by the general hypothesis that organizations whose internal features match the demands of their environments will achieve the best results (Scott, 1992). It follows from notions of requisite variety (Simon, 1957) that the more varied the demands of the environment, the more varied the available structural forms will need to be. The attraction of this approach is that rather than promoting a one-best-way perspective of organizing, it acknowledges a myriad of possible ways. Also, whereas the classical view largely ignores contingent influences, the contingency view allows for classical structures, save only that they align with the contingencies of their environment.

These notions are captured in the early work of Burns and Stalker (1961) who, having taken up the theme that there is no single set of principles for good organizing, made a simple yet useful illustration differentiating between mechanistic and organismic forms. They advocated that mechanistic forms would exist successfully under stable conditions that would allow for explicitly predictable ways of working using the precisely defined roles, duties and methods enshrined in strict bureaucratic principles. Conversely, in unstable, or in any sense unpredictable, conditions this precision is less attainable or may be wholly absent. Here the organismic form would be more successful since it allows for the individual or the team to act autonomously in loosely coupled networks, driven by their understanding of the instantaneous conditions.

A further contribution originated with the work of Lawrence and Lorsch (1967) who suggested that no organization should be seen as homogeneous and therefore the issue is to strike the right balance between differentiation and integration to reflect the different sub-environments within which each sub-organizational unit operates. While holding firm to their concept they deferred to Burns and Stalker (1961) by accepting that the less differentiated the sub-environments, the less differentiated the structure need be.

Over a similar period Woodward (1965) suggested that organizational structure was determined by the technology in use. Her contention, which can be located within a school of technological determinist scholars (see Walker and Guest, 1952; Sayles, 1958; Blauner, 1964) was that, rather than other environmental or social considerations being dominant, there was a particular form of organization appropriate to each technical situation. What remains moot is the extent to which the technology in use can be interpreted as part of the organizational environment. But, since the thrust of these approaches has so placed it we can reasonably infer that these scholars at least saw it as such.

Research by the Aston Group and others identified size, external dependency and technology as dominant contingency factors (Blau, 1970; Child, 1972; Donaldson,

1986; Pugh and Hickson, 1976). As a result they concluded for example that increased size meant increased bureaucratization.

Clearly recognizable in each case above is a common underlying contingency concept - that an organization's structure should be adapted to significant characteristics of its environment - even though the significant characteristics are neither uniformly conceptualized nor universally applied, nor perhaps even predictable. Accordingly, although we can locate the concepts within a common context it is more problematic to align the emergent theories, except at the meta-level of simple contingency. Furthermore, clearly evident in these and other contingency descriptions is a dominant normative interpretation (Legge, 1978). Here, contingency implies a reading of the organizational environment by managers and the suitable arrangement of organizational structure(s). Although, as Thompson and McHugh (1995) describe, its central appeal is that it takes an if-then approach rather than the one-best-way approach of the more classical interpretations, it apparently remains constrained by a relatively limited range of 'ifs' and commensurate 'thens', generally expressed in archetypal form, presumably for ease of digestion.

Contingency has also become generally analogous with decentralized structural attributes (Bedeian and Zammuto, 1991) and, to be sure, as environments become more dynamic then there is evidence of a trend towards more decentralized configurations (Buchanan and Huczynski, 1997; Hatch, 1997b; Gibson and Birkinshaw, 2004). But there is also indication that even this is too limiting an interpretation for very dynamic environments, requiring, it seems, that an organization should sit at a decentralized polar location predicated on some forecast of environment conditions. Nor is there strong evidence that any non-polar, intermediate archetype of quasi-enduring characteristics (see for example Burns and Stalker, 1961; Mintzberg, 1979) is particularly relevant. Indeed, I would argue that it is the apparently pervasive trend in the literature to identify limited repertoires of archetypal forms that hinders the identification of truly warrantable contingent configurations, since they will be more or less compromised by the need to conform to some delimited spectrum of antecedent archetypes. In this regard, Wheen (1995:4) makes a somewhat jocular yet perceptive observation when he suggests that:

> 'Following the distinguished example of God who condensed the laws of righteousness into 10 easy to understand commandments business authors seek to persuade readers that the secrets of success are finite and can be briefly enumerated.'

Equally significant, archetypal solutions are focused on structure or configuration as a state and remain largely silent on the issue of process, that is to say how these adaptations are arrived at. The interesting question is therefore, as environments become increasingly dynamic and more frequent/rapid configurational changes are required, how are these achieved?

2.2.3   The neo-contingency turn

What I have chosen to call the neo-contingency turn begins to address this issue. A number of scholars have begun to investigate interesting aspects of structure and configuration that are emerging from more contemporary practice. They are seeking

new explanations of how organizations use structures, the value that can derive from combining different structures and the ease of movement between structures.

Bigley and Roberts (2001) investigated the instrumentality of dual bureaucratic and autonomous approaches in a single organization, namely the incident command system as widely used by public safety organizations in the United States. They found that the two could co-exist with ease and to advantage but noted that the bureaucratic approach was evident and appropriate at higher hierarchical levels while the autonomous approach was evident and relevant a lower hierarchical levels. This was a case study and sought to develop substantive theory within a single domain about how just two structures co-exist, but thereby stayed true to extant archetypes.

Developing a similar theme, Gibson and Birkinshaw (2004), drew on notions of ambidexterity from Duncan (1976) and Tushman and O'Reilly (1996) to identify how different approaches can be employed. Beginning in a similar vein to Bigley and Roberts (2001), they identified different approaches at differentiated organizational levels in what they term structural ambidexterity. They then identified the use of different approaches at different times, in what they term temporal ambidexterity, and to satisfy conflicting demands, in what they term contextual ambidexterity. Their findings are interesting but are constrained both by the notion of ambidexterity, which connotes a choice between just two options, and by looking at the utility of different archetypes rather than at the dynamic processes involved.

The ease with which an organization can move between structural archetypes formed the basis of a research experiment by Moon *et al* (2004). They argued for a dynamic logic to replace the static logic of many contingency-based theories. Here they proposed that most research evidence in this field entails generalizations from static, between group comparisons rather than dynamic changes within a group. At the core of their experiment was a challenge to the assumption of symmetrical adaptation, that an organization can move with equal ease between divisional and functional structures. They established the asymmetry that it was easier to move from functional to divisional structures than vice versa. They conclude their paper with the very strong and somewhat contentious position that infinite flexibility is a myth and that future research should focus on identifying other asymmetries and how they can be offset.

The history of responsive operations reveals that carefully prepared approaches often fail practical implementation (Baldwin, 1966; De Segur, 2002; Wright, 2000). This failure is frequently seen to sit with top management and has been found to involve, *inter alia*, inflexible application of rigid rules in dynamically evolving situations, inability to envision future consequences of present actions, and personal timidity that precludes effective deployment of available resources (Alexander, 2002; Hough, 2001; von Manstein, 1958).

Two themes seem to weave inexorably through the whole of the contingency debate and therefore remain evident in these neo-contingency examples. The first is the search for evermore warranted explanations of structural/configurational approaches that meet the demands of increasingly dynamic and unpredictable environments. The second is, somewhat paradoxically, the almost umbilical attachment to extant archetypes and the apparent wish to explain all new insights in this constrained context.

The doctrine that lies behind many of the espoused contingency perspectives rehearsed previously and at the source of the failures mentioned above reflects a pre-emptive bias. Clancey (1991) and von Lubitz *et al* (2004) both suggest that this often remains blind to the realities of high velocity and error sensitive conditions, e.g. unpredictability, confusion, inadequacy of immediately available resources, involvement of unplanned factors and discontinuous temporal patterns. As a result, predetermination of events and preparation for their occurrence, even taken from a nominally contingency point of view, tends to lead to a preponderance of equally predetermined action (von Lubitz *et al*, 2004). The action is therefore initiated and continues because it is planned rather than because it is appropriate (Clancey, 1991) and this outcome further illustrates the pervasive influence, and practical inadequacy, of archetypal explications.

Conversely, a reactive bias connotes the sudden emergence of a situation, the dynamic nature of which requires flexibility and fluidity based on the contingent characteristics of the situation together with allocation of the available resources to contain its most immediate and significant sequelae. This process then iterates as the situation evolves (Clancey, 1991).

In this context, Moon *et al* (2004) argue that the allure of flexibility based on infinitely adaptable people and organizational forms must be balanced against the inherent difficulties of achieving and maintaining high levels of adaptation in organizations. Conversely, my personal experience of rapid configurational changes suggests to me that such flexibility is far from being a myth and may have expressions that are orders of magnitude greater than the delimited archetypes of much research output identified by Wheen (1995). However, with regard to research approach Moon *et al* (2004) go on to argue that the dominant evidence base that supports contingency theoretic research endeavours tends to focus on generalizations adduced from static snapshots of different groups in different situations. They propose that it would be interesting to look at the dynamics of within group adaptations as situations change. Significantly they note that:

> '…little of the empirical research in support of contingency theories in general, or structural contingency theory specifically, has spoken directly to the issue of change and adaptability over time or across environments'. (2004: 681-682)

In seeking to address these theoretical and methodological issues I have chosen to follow Moon *et al* (2004) and adopt a dynamic perspective on within-group configurational changes in preference to static between group archetypal exemplars.

At the heart of this research then lies the personal view that we can achieve a more practical understanding of the field if we avoid the quasi-static nature of pair wise, if-then comparisons of archetypal explanations. Instead my purpose is to investigate the process(es) by which organizations configure to meet the demands of their environments. Further, to extend the context beyond the limits of contemporary neo-contingency research and to look at organizations that work in unpredictable, high velocity, error sensitive environments. It seems to me that by understanding this mechanism we can at least begin to advance beyond theory that identifies and defines crisp archetypes to theory that describes the processes by which contingencies are handled.

2.3 An empirical opportunity

To summarize, the development of organization theory over a period of some 150 years has revealed a wide range of perspectives and theories, cast in part from the variety of contributing disciplines (Hatch, 1997b). However, one theme that has intrigued a range of scholars for at least the last sixty years is how organizations can best configure themselves to treat with the contingencies of their respective environments (Donaldson, 2001). The structural overtones of much of the early literature (Burns and Stalker, 1961; Donaldson, 2001; Lawrence and Lorsch, 1967) tended to purvey the notion that by identifying a delimited range of significant environmental characteristics, a delimited repertoire of suitable organizational arrangements could be designed.

More recently, research has acknowledged that the social and commercial environments are becoming more unpredictable with increasing velocity and error sensitivity (Brown and Eisenhardt, 1997; Clancey, 1991). This has led researchers to seek better archetypal explanations (Bigley and Roberts, 2001; Gibson and Birkinshaw, 2004). My concern is that in some environments the requisite variety (Simon, 1957) of archetypes may not be enumerated, either briefly or indeed at all. In such environments what may be more significant is the process by which configuration takes place, given the experienced contingencies. Thus by understanding the configuring process actors may need no longer learn or search for suitable archetypes but configure themselves in wholly practical, contingent ways.

This approach therefore holds the potential to advance current theoretical positions without attempting to diminish them. In this regard my approach is similar to the way in which Einstein built on the magisterial work of Newton by considering extreme contingencies not approached by his illustrious forebear (see Hawking, 2002), but without laying claim to such fundamental or erudite contribution.

In identifying a suitable and interesting empirical opportunity I have therefore considered the constraints in much that has been written about contingent structures and configurations. We can identify for example a focus on whole organizations, macro influences and quasi-enduring states in the work of Burns and Stalker (1961), Lawrence and Lorsch (1967), Mintzberg (1979), Pugh and Hickson (1976), and Woodward (1965), which authors have also by accident or design produced limited repertoires of archetypal forms. Even when contingency view investigations have focused on increasingly dynamic environments the decision cycles have tended to be in the order of many weeks if not months (Eisenhardt, 1989). Perhaps most surprisingly in what is by general repute a messy field (Parkhe, 1993), these studies have tended to propose crisp cause-effect relationships. Even more recent studies (Bigley and Roberts, 2001; Gibson and Birkinshaw, 2004; Moon *et al*, 2004) look at how whole organizations differentiate structural, temporal and contextual forms to meet diverse yet quasi-enduring needs. Given that it is in the nature of a contingency view that unpredictable causal influences may require unspecifiable configurational responses, I conjectured that perhaps some other linkage would have more explanatory power and practical utility.

Although in this study I am interested in the general topic of how organizations configure to align with different environmental demands I am specifically interested in

this phenomenon as a continuing requirement in very dynamic circumstances. I therefore decided that, as Pettigrew (1974) suggests, studying extreme environments would hold the best chance of revealing new and interesting insights. Interpreting extreme as dramatic, spontaneous and intense experience, Pettigrew (1974) proposes that such experience has the highest learning potential to which we can add that they are also more likely to require novel responses (Ryle, 1979; MacLean, 1992). He notes that in dramatic and intense situations, factors such as the signal-noise ratio may mask the available lessons and that the fatigue induced by the situation may limit the learning that in fact takes place, either contemporaneously with the action or subsequently by reflection.

Turning these notions to advantage, here I propose that, while Pettigrew is speaking of high learning potential for actors, the same argument is also valid for researchers. By analogy, by researching in extreme environments, the value of the research outcomes have high potential but, since the researcher is observing rather than participating in the extreme situation, and subsequently reflecting on possible reasons for observed phenomena, he/she is therefore better placed to penetrate the noise to find the signal, at the same time remaining less prone to the limitations imposed by physical and mental fatigue. In addition, the researcher brings academic skills perhaps not available to actors.

Finally, following the lead of a range of scholars (e.g. Ginnett, 1988; Hutchins, 2000; Weick and Roberts, 1993) I have chosen to investigate at the meso-level of the work-group or team. From a theoretical perspective, Whetten (1989, 2000) suggests that this helps to limit the scope of the research task while still offering good opportunities for sound theoretical contribution. But also, of practical significance, teams are rapidly becoming the fundamental work group (Gordon, 1992), which Katzenbach and Smith (1993) identify as central to performance. Further, self managed work teams (Cohen *et al*, 1996) have been demonstrated to be fundamental in producing the fast, flexible and creative responses denied to whole large organizations (Lipman-Blumen and Leavitt, 1999). The phenomenon is therefore more likely to be observable at the team level.

2.3.1   Research question and aim of the thesis

The foregoing therefore gives rise to the single research question:

> 'How do teams configure in unpredictable, high velocity, error sensitive circumstances?'

The aim of the thesis is to make a theoretical contribution to contingency theoretic perspectives and a functional contribution to practice by revealing the empirically derived and theoretically informed processes by which teams configure responses to contingent aspects of their environments.

CHAPTER 3

METHODOLOGY

3.1 Introduction

I now address a range of issues that bear, both directly and more peripherally, on the research approach that I adopted. In explaining how I arrived at my methodology, I acknowledge the external and internal influences on the methodological decisions I made, and reveal the sources of and the connections between the purpose of the research, the philosophical and theoretical perspectives I took and the research question previously described in Chapter 2. Set against this background I explain in detail the research design and the methods that I employed to collect and analyze data.

3.1.1 A note on methodology and methods

As Plotkin (1995) proposes, it is well to be clear as to the definitions or descriptions we use in research since they not only aid understanding by the reader but also make clear the preferences and perhaps even prejudices of the author/researcher. Accordingly, throughout this thesis, following Blaikie (1993), I understand methodology to represent the theory of how research should be undertaken. In this endeavour it seeks to guide the development of rigorous, comprehensive and integrated approaches based on critical assessment of a range of influences and options. Blaikie (1993) goes on to suggest that these include, inter alia, the topic of research, underlying philosophical inclinations about how theory should be generated and/or tested, what criteria need to be satisfied and what resources are available. Conversely, although frequently conflated or confused with methodology, the methods of research are more precisely the styles, techniques and procedures actually used to gather and analyze data (Blaikie, 1993). I develop these basic ideas in more detail as this chapter progresses.

3.2 Arriving at a methodology

Arriving at a methodology is a complex process. The range of methodological literature that explains the different approaches to research that have developed, in both the natural and social sciences, bears witness to how diverse the options are, how problematic the choices may be and how these are intimately connected to different philosophical and theoretical perspectives (see for example: Blaikie, 1993; Easterby-Smith, Thorpe and Lowe, 2002; Gill and Johnson, 2002; Guba and Lincoln, 1994; Johnson and Duberley, 2000; Locke, 2001). However, I am concerned here with organizational research as a field within social science and will have little to say about the natural sciences.

Models abound that seek to assist organizational researchers in navigating the inherent complexities and perhaps conflicts involved. While my approach to all methodological models is that they are necessarily wrong, at least because they are a distillation of ideas by virtue of the level of abstraction involved, I also accept that, as a guide for how an issue might be resolved, they are essential and extremely helpful. Partington (2000b) for example, suggests that the level of consideration lies somewhere between simply applying an established, normative approach with little further comment and

reconstructing the entire philosophy of science to arrive at a unique approach. His advice, however, is to find and explain an approach that is appropriate to the requirements of the research and its context rather than to favour either extreme. This advice echoes that of Emmett (1972), to adopt a style that is essentially a matter of convenience, employing an approach that is relevant and helpful to the subject matter and the method of enquiry, rather than given as an absolute. Accordingly, I now explain the thinking that brought me to my chosen approach.

3.2.1 Metaphysically-based models of the research process

But, to place my decision in its broader context, I will begin by briefly returning to two models, deemed representative of the field. The models under consideration here integrate contributions from a range of scholarly endeavour in order to represent the options available. Variously more or less prescriptive as to the approaches to research, they usefully indicate how philosophical, theoretical and methodological perspectives might be aligned. Common to both is that they begin with metaphysical deliberation. Typically, models that seek to represent the nature of scientific research tend to employ polar dimensions of key characteristics, perhaps incorporating more or less detailed continua between the poles as in Figure 3.1 (Hussey and Hussey, 1997; augmented by Gill and Johnson, 1997), or employ a multi-layered approach to suggest a more embedded conception (Saunders *et al.* 2003) as in Figure 3.2.

Typical of the polarized representation, the Hussey and Hussey (1997) model portrays the range of philosophical perspectives (1), in relation to core assumptions about the nature of reality (2), the corresponding approaches to scientific investigation (3), followed by related strategies (4) and (5), with examples of associated methods (6).

(1)	Subjectivist					Objectivist
(2)	Projection of Human Imagination	Social Construct	Symbolic Discourse	Contextual Field	Concrete Process	Concrete Structure
(3)	Phenomenological					Positivist
(4)	Ideographic (Inductive)					Nomothetic (Deductive)
(5)	Qualitative					Quantitative
(6)	Ethnography	Action Research	Surveys		Quasi-Experiment	Laboratory Experiment

Figure 3.1   The nature of scientific enquiry (after Hussey and Hussey 1997)

Following a similar logic, but using a more embedded conception, the Saunders *et al.* (2003) model, shown as Figure 3.2, depicts what they refer to as the research process 'onion'. This nested hierarchy seeks to avoid the strict polarity apparent within the previous model, while retaining the conceptual identity of the different layers and still indicating potential associations between layers. But, even here some polarity is evident as there is an explicit connection horizontally between the categories embedded in each of the layers.

24

Data Collection	Strategy	Approach	Philosophy

```
                                                        Deductive        Positivism
         Sampling          Experiment
         Secondary         Survey
         Data              Case Study
         Observation       Grounded                                       Realism
                           Theory
                           Ethnography
                           Action Research
                                                        Inductive        Interpretivism
```
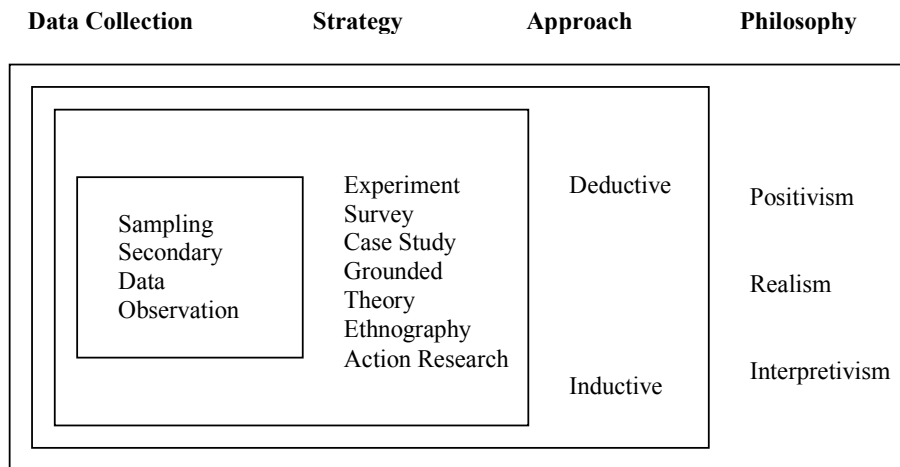
Figure 3.2   *The nature of scientific enquiry (after Saunders* **et al***, 2003)*

Both these representations draw together contributions from a number of methodological theorists into integrated models of the key issues in research. Importantly, they identify the issues that require attention if the research is to be credible. Fundamental to each is a process that leads from initial considerations of underlying metaphysical perspectives to methods of data collection and analysis. But, it is clear from just these two representations that even among leading scholars there are at least representational differences that may indicate conceptual differences. Here for example, the basic philosophical perspectives are referred to differently, the ordering of ethnography and action research is reversed, as are some proposed relationships with methods of data collection.

But caution is required with regard to the implied relationships between layers of essentially binary pairings in both models. Thus, for example, positivism implies a deductive approach favouring experiment or survey and sampling, and so on. However, Byrne (1998) warns that the horizontal binary pairings, and intermediate characteristics, where expressed, although related vertically should not be interpreted as invariably synonymous, even though they may have valid relationships in some circumstances. This view resonates with that of Cohen and Stewart (1995), who contend that models (of all kinds) do not represent fundamental truths about reality, they are merely convenient conceptual representations; they may be good bad or indifferent depending on the context of application. Further, Gill and Johnson (2002) observe that it remains moot whether somewhat linear representations of what is by general repute a more iterative, even messy, process are valid, while Crossan (2004) doubts that strict distinctions between qualitative and quantitative approaches, including their underlying philosophical and methodological assumptions, remain valid. In terms, these scholars agree that the approach used should depend on the purpose for which it is being used and the range of phenomena that we want to understand rather than adherence to any prescription. This implies that we may with care and advantage also usefully develop a unique model.

Viewing these and other perspectives it seems that one man's approach can be another man's strategy, which in turn can be another man's methodology. However, I am sure that we should not let terminological inconsistencies become insurmountable obstacles, even though the issues they address are non-trivial; that such inconsistencies exist does not discredit the whole research process. Rather, they simply but eloquently serve to emphasize the need, previously cited from Plotkin (1995), for each individual researcher to be explicit about his or her location in relation to the research process. In essence, to find an approach, however individual, that provides a warrantable resolution of the issues involved that is both logical in its derivation and pragmatic in its application.

3.2.2   Activity-based models of research

An approach that acknowledges a more cyclical, iterative and therefore active nature of research, the Kolb experiential learning cycle (Kolb *et al.* 1979) shown as Figure 3.3, provides a simple yet authoritative model of the processes evident in all research activity. The model illustrates the cyclical relationship between induction (moving from data to theory) and deduction (moving from theory to data) and, as Law and Lodge (1984) observe, allows theories to be continuously adjusted in the light of new experience. This resonates with, Schon's (1983) notion of reflection in action, which he describes as a continuous discourse between actors and situations. He recommends comparing thoughts actions and outcomes in a manner that mirrors Kolb's formalization.
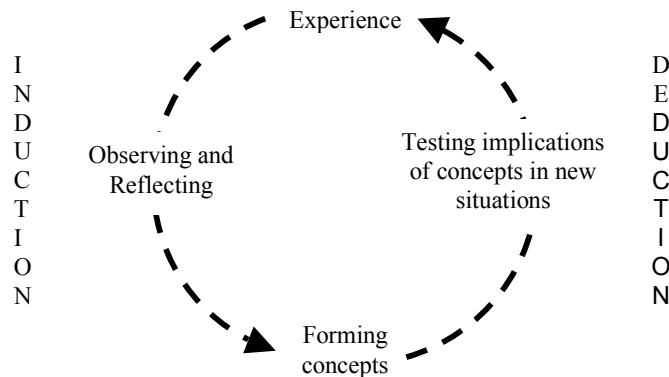
Figure 3.3   The Kolb experiential learning cycle (adapted from Kolb, Rubin and McIntyre, 1979)

This representation allows the process to be initiated at any point in the cycle and, although the authors remain purposely agnostic as to which is the better starting point, their preference is perhaps indicated in the title. The Kolb Cycle has a distinguished pedigree, deriving from Aristotle's concept of how we learn. More positively, Aristotle proposed in his *Posterior Analytics* (see Barnes, 1975) that all scientific enquiry begins with observation, from which the scientist forms explanatory principles (induction), from which s/he may then form statements that include those explanatory principles (deduction), which are, in turn, tested by further observation. The graphical representation of the original Aristotelian perspective in Figure 3.4 is more parsimonious even than Kolb. Nonetheless, this representation, taken from Losee

(1993), still makes clear both the essential differences and interrelationships between induction and deduction as processes in scientific investigation.

Induction

Explanatory
principles

Observations

Deduction
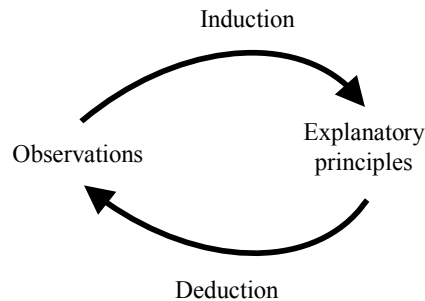
Figure 3.4   ***Aristotelian method of science (source: Losee, 1993)***

But more importantly, whatever the starting point adopted, the process is easily seen as continuous rather than having an algorithmically determined stopping rule (Rittel and Webber, 1973). For me, it is this notion of science as an incremental, cyclical and open-ended process (Lawson, 2002), which nonetheless includes some radical contributions, which is both beguiling and encouraging of continuous endeavour. Consequently, the most useful service that these and similar models provide is as generalized abstractions of the methodological territory, suggesting the implications of methodological choices rather than being prescriptive about any specific choice.

3.2.3   A practical resolution

Seeking to render the process more approachable, I found that such complexities and inconsistencies as exist both within and between approaches, and as are illustrated by the differences in above models, could be resolved by taking an Aristotelian perspective and looking first at the structure of research as a practice rather than as an exercise in metaphysics. Viewed from this perspective, the methodological and philosophical considerations are connected logically and practically to the research, as it will be conducted in the field or indeed in the laboratory. This process effectively reverses those traditionally espoused philosophical perspectives on method development that begin from a metaphysical standpoint. The model shown as Figure 3.5 therefore represents a novel typology of research.

Adapted from Wilson (1999), it identifies the fundamental activities of the research process and, by focusing on simple characteristics, provides a parsimonious yet powerful way to avoid some of the obstacles of the earlier models in reaching initial decisions. The logic of this model does not absolve the researcher from revealing and explaining the underlying arguments. Rather, it assists early decisions about method and methodology by considering the structure of the actual activity of the intended research before moving towards more metaphysical deliberation.

In a logical development from Aristotle (see Losee, 1993) via Kolb (1979) this model therefore accepts as fundamental the proposition that all research is based on

observation, for example: of the heavens in astronomy, of phenomena across a spectrum of scales in physics, and of social groupings and behaviour in sociology. Indeed, we can legitimately argue that for every discipline the fundamental method of data collection begins with observation albeit that over history the sophistication of instruments and methods has improved (Wilson, 1999).

In Wilson's (1999) interpretation (Figure 3.5) observation is initially classified as direct or indirect. In *direct* observation the researcher is the observer and records what s/he sees, while in *indirect* observation the researcher relies on observations, which can include self-observation or reflection (Schon, 1983), reported by informants. It is generally the case that the natural sciences tend to prefer direct observation while in the social sciences observation may be either direct, as in ethnographic studies, or indirect, as in the perusal of textual or numerical data (Wilson, 1999; Bryman and Bell, 2003). There is a further interesting issue relating to direct or indirect observation since, as Partington (2000a) observes, the ontological status of direct observation by the researcher is different from indirect observation of retrospective accounts in that they represent different levels of reality. I return to this issue later in describing my philosophical perspective.

The next step is to consider the extent to which this observation is, or indeed can be, structured. As Wilson (1999) notes, all research methods involve some form of structure based on anything from a strong testable hypothesis and experimental method to perhaps nothing more than a general concept or experience of the phenomenon of interest, or simply the objectives of the research. At one extreme he suggests that the structure can be *imposed*; this may be via the ability to initiate and/or manipulate the phenomenon and isolate it from or control for other influences, or by the design of a formal questionnaire in which the questions necessarily constrain the answers. However, it may be that the researcher wishes to put much of this aside and see the structure as *emergent*, from the research process itself, with no strong *a priori* concepts involved.

As a consequence of the above, it is then possible to suggest rather than prescribe suitable research methods or techniques. In the model I have included a single example for each, which also stand as proxy for cognates.

		Structure	
		Imposed	*Emergent*
Observation	*Direct*	Experiment	Ethnography
	Indirect	Questionnaire	Interview

Figure 3.5   A practical model for research (after Wilson, 1999)

Even within this general arrangement, we are not led to automatic decisions, much less prescriptions, about methods. Rather, it allows for logical navigation of the methodological field and offers guidance as to appropriate methods, especially when

integrated with the logic that underpins other models of research, a few examples of which have been introduced previously.

For example, Johnson and Harris (2002) are in agreement with Wilson (1999) that it may be more appropriate and practical to impose structure when the nature of the research problem is well understood and in relation to which strong, valid hypotheses can be tested. Conversely, when a field or phenomenon of interest is not well understood, or where the intelligent interpretations of actors intervene, by allowing structure to emerge from the research itself we enable new theory and new insights to develop. Johnson and Harris (2002) go further to propose that in most cases the former will favour the collection of quantitative data for hypothesis testing while the latter will favour the collection of qualitative data for theory building although, again, this does not represent a strict distinction or rule.

Linking these insights back to the mainstream of methodological interpretation (Bryman and Bell, 2003; Gill and Johnson, 2003; Saunders *et al*, 2003) the first would align with the realist ontology (phenomena exist as mind independent reality) and the positivist epistemology (a research process that assumes theory neutral explanation of behaviour); the second would be closer to the constructivist ontology (phenomena exist as a construction of the human mind) and the interpretivist epistemology (a research process that seeks to understand human behaviour on the basis of individual interpretations). But again, from inspection it appears that, rather unhelpfully, the very simplicity that these polarized representations seek to portray requires that particular ontological locations imply particular epistemological approaches.

However, as I explain in the next sections, I developed an approach that would reveal informants understandings of behaviours that held a reality for them; in essence, I adopted an epistemological location that would reveal informants interpretations of their reality coupled with an ontology that linked experience with dissimilar levels of reality.

3.3   Integrating research approach, philosophy and strategy

To recapitulate, in this research my focus was on how teams working in extreme environments configure their behaviour, a phenomenon about which little is currently known, and I wanted to understand it from the perspective of the actors involved. Furthermore, given this objective, it was of limited interest merely to describe particular behaviours in particular circumstances. I wanted to be able to identify, if only through warranted speculation, the process or mechanism that produced these behaviours. To this end, I wanted to capture both historical and contemporary data on a wide spectrum of events that limited observation would not have revealed.

Importantly, I was more interested in developing understanding than predicting outcomes and so, following the logic and guidance in Wilson's (1999) model, and as supported by Johnson and Harris (2002), I therefore decided that the practical solution was to adopt a qualitative approach to benefit from the depth of investigation it offered (Myers, 2000), content that this would be both fruitful in the qualitative data it produced and economical in the observational time it required because it would use indirect rather than direct techniques. This approach would also keep the research connected to the

real world by describing processes in their proper context (Kemmis, 1980), exploring the processes as they unfolded (Hartley, 1994).

I also wanted the structure of the research to emerge from the research process to inform the generation of new insights for both theory and practice that remain currently so sparse in this field. I therefore integrated this general concept within an established inductive approach to the generation of theory from data using a philosophical perspective and speculation strategy that was commensurate with the phenomenon of interest and my research aims (see Chapter 2, Section 2.3.1). I now explain each in turn.

3.3.1   Adopting the grounded theory approach

The approach to theory development known as grounded theory (Glaser and Strauss, 1967; Strauss and Corbin, 1990) provides an excellent vehicle for just this kind of research. Its origins lie in the tradition of symbolic interactionism developed by Mead (1934), Blumer (1969) and others to understand social processes from the actor's point of view, 'on the basis of what he notes, interprets and assesses' (Blumer, 1969:34). Snape and Spencer (2003) suggest that fundamental to this concept is the notion that instead of researchers taking an authoritative, neutral stance in their investigations, a more collaborative relationship should exist within which informants can tell their own stories and reveal what Calori (2000) refers to as ordinary theories. Further, meanings can be negotiated between researchers and researched and reality approached through a process of intersubjectivity, establishing consensual (Gouldner, 1970) rather than absolute validity. Importantly for this research, Delbridge and Kirkpatrick (1994) suggest that from this approach it is possible to understand how behaviour, particularly team behaviour, changes as circumstances change.

But grounded theory was and remains more than simply a process of theory development that is grounded in data. It is implicit in the joint and several works of Glaser, Strauss, Corbin and others that the term grounded theory refers to a process. However, although much cited in the organizational literature, Bryman (1988) and Bryman and Bell (2003) note that its methods and techniques remain contentious, not least between its original authors who developed the approach along different paths after publication of the original text (Glaser and Strauss, 1967). Whereas Glaser (1992) has sought continuously to promote a highly flexible approach dependent as much on the latent creativity and ingenuity of the researcher as on any procedural guidance, Strauss (1987) and Strauss and Corbin (1990) have developed an ever more highly systematized and generally applicable version. In my view it is this attempt at strict systematization and general applicability that is the major limitation in the admittedly magisterial work of Strauss and Corbin, although it retains many useful insights. Paradoxically, one part of the process of development is clear from the shift that both authors made from their initial view (Glaser and Strauss, 1967) that grounded theory was uniquely the domain of professionally trained sociologists to one accepting that the approach was adaptable to a variety of fields and disciplines (Glaser, 1978; Strauss and Corbin, 1990), although perhaps more especially in the social sciences.

This inherent adaptability has made the approach very popular in the many areas of organizational research although, as Bryman and Bell (2003) further identify, too ecumenical an approach can lead to relativism, based on ill-defined concepts and methods, masquerading as grounded theory. In this research, therefore, I opted to use the highly flexible approach espoused by Glaser (1978, 1992) but determined to make explicit the concepts and methods on which my individual interpretation depended.

The Glaserian approach encompasses the freedom to speculate on developing elements of the theory rather than simply to produce a range of procedurally linked concepts as espoused by Strauss and Corbin (1990). Glaser (1992) explicitly allows for considerable freedom in speculating beyond the raw data to draw generalizations from what Mintzberg (1979) refers to as creative leaps, rather than to depend on strict adherence to procedural rules and the constraints of conditional matrices. However, in spite of his somewhat free-form approach Glaser's ultimate and explicit interest remained in the development of strong sociological constructs (1978).

Although I am not a trained sociologist, I am intrigued by the processes of organizational life. As I described in Chapters 1 and 2, my research was inspired by the wish to generate a theoretical explanation for poorly researched phenomena in a discrete context using a style that Piantanida *et al* have since described as 'grounded in the practices of that context and useful for enacting those practices' (2002:1). Equally, by researching in extreme situations, as described by Pettigrew (1974) I took the view that, even for a relatively novice researcher, this kind of investigation held the potential to produce interesting contributions to both theory and practice and perhaps have relevance beyond the delimited context of the research.

Acknowledging that some risk attaches to interpreting an established approach too liberally, I decided that grounded theory still offered the best potential to satisfy the methodological and outcome requirements of the research. In this I was guided by the general notion that typical as units of analysis in grounded theory studies are patterns of actors behaviour and by the four criteria emphasized by Glaser (1992). According to Glaser (1992) theory thus adduced should meet four criteria: first the theory should 'fit' the data in that its attributes should match the realities under investigation; second, it should 'work' in that it should explain the behaviour within and across the domains; third, it should be relevant to the informants, and; fourth, it should be readily modifiable as a result of further research.

I was also convinced that the key to successful variation of any method was to remain true to fundamental tenets of the original. Here, both Glaser and Strauss agree that the fundamental tenets of grounded theory are theoretical sampling and constant comparison. According to Glaser (1992) theoretical sampling entails that the data collection strategy and schedule is dictated by the emerging theory rather than by any predefinition while constant comparison involves comparing instances of data with other instances in order to develop semi-stable categories. As the data collection and analysis progress in concert, this comparison becomes between new data and categories of the emerging theory.

I return to these tenets later when I describe data collection and analysis in more detail in Section 3.4.

3.3.2   Taking the critical realist perspective

Returning to Partington's (2000a) comment regarding the differences in ontological status of direct and indirect observation, I required a philosophical perspective that could encompass not only the ontological differences between the vicarious experience of the researcher and the actual experience of the informants but also between those experiences and the process or mechanism that generates them.

The realist perspective holds that there is an external reality that exists independent of our descriptions of it. But there are two discrete understandings of in what that reality exists. Empirical realism asserts that reality can be experienced and understood directly through the use of suitable methods and is most evident in the positivist concept (Bryman and Bell, 2003). However, Bhaskar contends that this superficial interpretation fails to recognize and therefore fails to identify deeper structures and mechanisms that produce experienced phenomena (1989). As a result, Bhaskar in his earlier, seminal explication of critical realism proposed that there were three overlapping domains of reality; the empirical domain consisting of events we experience; the actual domain consisting of events that occur whether or not we experience them and the real domain consisting of the mechanisms and tendencies that produce these events (1975). These are shown diagrammatically in Figure 3.6
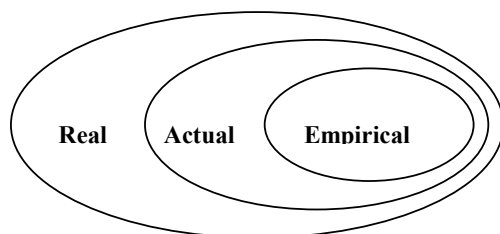
Figure 3.6   Bhaskar's multi-level ontology (source Bhaskar (1975:56)

He had further proposed that these mechanisms were not spontaneously apparent in observable patterns of events; they therefore could only be identified through social scientific research that admitted of speculation on hypothetical entities to explain them. Thus his approach bridged without compromise the extremes of positivism, because management behaviour may not be observable in an objective way, and interpretivism, because it embraces researcher speculation as a warranted analytical device.

The value of this philosophical perspective is that in itself it acknowledges differences in ontological status and it aligns with the general methodological development I have described. However, since the mechanisms that constitute the domain of the real are held not to be spontaneously evident it requires a suitable strategy on which speculation as to the attributes of such mechanisms might be based. The logical contender here is retroduction.

3.3.3   Employing a retroductive strategy

The strategy by which the data can support insights not evident in observation or raw data is referred to as retroduction. It connotes the continuous iterative process between inductive and deductive reasoning (Blaikie, 1993). As explicated by Peirce (1934), retroduction is the process by which we propose something that has not, or could not be, observed directly. Bhaskar (1979) endorses this strategy as a way of identifying and representing the real mechanisms that underpin his multi-level ontology. He suggests that it is fundamental to his earlier thesis (Bhaskar, 1975) that we are constrained to speculate on the existence of a mechanism that, were it to exist in the postulated way would account for the empirical phenomenon in question. He also accepts that the very act of speculation implies that the postulate is not claimed to be true in some absolute sense but does need to be compelling given the evidence. That is to say that it has good explanatory power. Pierce had previously captured this simple but elegant notion as, 'The surprising fact C is observed, but if A were true then C would be a matter of course, hence there is reason to suppose that A is true' (1934:117). It follows that evidence for the existence of A may then emerge from further example or from the elimination of alternative explanations (Harrison, 2001) or indeed the whole initial speculation may be superceded by a more compelling explanation.

3.3.4   Recapitulation

In organizational research, one of the key limitations of attempting to use concepts still prevalent in the natural sciences and embodied in many of the general models of the research process is their paradigmatic nature (Kuhn, 1970). As explained by Kuhn (1970) this concept tends to invoke a normative philosophical perspective (generally realism-cum-positivism), go on to identify what questions are permissible within the field (generally theory testing) and what methods are suitable for investigation (generally quantitative) and ultimately what outcomes are acceptable (generally expressions of statistical significance). Even within the social sciences this continuance of paradigm concepts is sometimes invoked (see Burrell and Morgan, 1979). It also seems to be an indivisible element of these paradigmatic approaches that research necessarily progresses in this direction - from philosophy to method. I have argued here that meaningful research benefits from reversing the process, freeing us from the constraint of paradigm, at least as an *ante hoc* concept, and allowing the objectives to guide the process rather than vice versa.

Accordingly, in this research I preferred to follow Wilson (1999), who suggests that we can invoke a process that moves in precisely the opposite direction, from method to philosophy. The process begins by conceiving of research as an activity based on some simple assumptions about observation and structure. These reveal method options that can be integrated into a broader research framework that integrates approach and strategy, reflection on which in turn reveals the underlying philosophical perspective.

The decision to use an indirect and emergent approach (Wilson, 1999) led logically to the adoption of an established yet flexible version of grounded theory (Glaser, 1978; 1992). Next, to assimilate the differences in ontological status of mechanisms, events, experiences and explanations, I adopted the multi-level ontology of Bhaskar's critical realism (1975). The logical concomitant of the critical realism perspective is a

retroductive strategy (Peirce, 1934) to facilitate speculation on the attributes of the mechanism that constitutes the domain of the real. It is against this background that I now explain the research design and methods I adopted for the field studies within this research

3.4 Research design and methods

Against the background of methodological development cited above, it is appropriate to describe in more detail the research design and methods used in the research. This includes some thoughts on a framework for the research that informed the design process and an explanation of the use of case studies as the basis of the research. This leads into a description of the data collection and analysis process on which the grounded theory is based.

3.4.1 Developing an initial theoretical framework

Notwithstanding the use of a grounded theory and its assumption-free point of departure (Glaser, 1992), it is generally accepted that it is not possible to approach any research endeavour wholly *tabula rasa*. Contrasting with the contention of positivism, Gill and Johnson (2002) argue that there seems little possibility of adopting a wholly theory neutral perspective in research, particularly when investigating social phenomena. Further, Easterby-Smith et al (2002) suggest that if research is to be meaningful it is extremely difficult if not impossible to work without at least an outline theoretical framework. Importantly, this is not the same as the hypothetico-deductive process in which a theory generates hypotheses that are operationalized as variables (Wallace 1983). Rather, by being explicit about the use of a framework, underlying assumptions are revealed together with what guided and limited the research process so that the reader may independently assess its credibility.

As already described, in this research I adopted a critical realist perspective (Bhaskar 1975) and aligned this with a retroductive strategy, to work from the lay accounts of social actors to the generation of theory; a relationship that Bhaskar (1979) has described as the central question of method for social science. But this relationship follows from some earlier assumptions. More completely, the strategy adopted here derives from the theoretical framework (adapted from Blaikie, 1993), described below and summarized in Figure 3.7. It will be clear from this framework that it represents a conceptual hypothesis regarding the research process to aid design, data collection, and analysis and theory construction. It makes no *a priori* assertions about the research topic or potential outcomes.

> Individual's concepts and meanings inform their social action/interaction, about which they can produce subjective accounts, from which the researcher can elicit social scientific descriptions of underlying mechanisms, which generate theory.

Individual concepts and meanings —— *inform* → Social actions and interaction —— *produce* → Subjective accounts

Social theories ← *generate* —— Scientific descriptions of mechanisms ← *elicit*
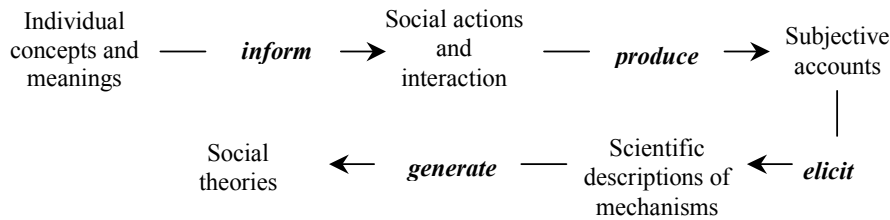
Figure 3.7   Initial theoretical framework (after Blaikie, 1993)

3.4.2   Using case studies

Qualitative research studies social phenomena from the perspective of the informants (Banister *et al*, 1994). Within this general tradition, case studies have an important function in theory building, especially when investigating emergent organizational behaviour that is informal or unusual, when current theory is weak or under-developed and there are potentially many variables whose connections are not immediately obvious (Hartley, 1994). Hartley goes on to suggest more specifically that case studies allow us to explore social processes as they unfold, in their natural organizational and environmental context, often revealing uniqueness rather than typicality. Similarly, Jones (1987) proposes that by engaging closely with the informant's domain we can capture the concepts and categories used by the informants to organize their world and therefore aid the emergence of new insights. Yin (1994) notes that cases studies are also useful when the boundaries between context and phenomena are not clearly evident and context is deliberately part of the design.

When researching in a field for which little or no formal theory exists or, as here, when new insights are sought, the value of a qualitative, theory building approach to case study becomes evident (Bryman and Bell, 2003). As previously cited, Johnson and Harris (2001) suggest that a strong argument in favour of the qualitative/inductive approach is the potential to answer not only the research question but also questions not originally asked. They contend that when the research is conducted from the perspective of the informant, and the researcher remains open to surprise rather than seeking to confirm expectations, ever more interesting insights can emerge from fieldwork.

The kind of focus, depth and detail proposed by these scholars represents an almost axiomatic description of and argument for the use of case study. While the criteria evinced above have discrete characteristics it is clear by inspection that they also emerge from a common underlying theme. To paraphrase, this can be stated as follows. When new insights are sought and when it is deemed important to reveal and to understand the unique perspectives of informants within their natural organizational contexts and environments then the argument for adopting a qualitative, inductive case based approach is strong.

3.4.3   Designing the research

Each of the notions advanced in the previous paragraphs resonates with the needs and intentions of this investigation and so the use of a case based, qualitative and inductive approach held clear attractions for my research. As an extension of this basic logic, having established a fundamental context of 'unpredictable, high velocity, error sensitive environments' I concluded that it would be useful triangulation to investigate using a multiple case study design. The purpose of using several cases was to see if general context (similarities) or specific case (dissimilarities) would reveal the most compelling evidence. Yin (1994) suggests that the underlying logic and therefore guiding principle for case selection is replication (rather than sampling). In his formulation, literal replication is used when similar results are expected across cases while theoretical replication is used when contrasting results are expected. Within a theory building approach I could not make any such predictions. However, I decided that selecting apparently different cases would allow literal or theoretical replication to be an emergent feature of the research rather than an *a priori* characteristic.

Accordingly, within the general context, I selected three cases in which teams routinely experienced the same contextual characteristics of unpredictability, high velocity and error sensitivity but in fundamentally different fields. In order to locate the cases within the general context I chose to use the term domain instead of case. Following Gardner (1997), I understand a domain to be more descriptively rich than a case, expressed as an area of human practice valued by society and mastered through a recognized apprenticeship. With this guiding concept the three selected domains were: a trauma team in an accident and emergency unit; a controller team in an air traffic control centre, and; a watch in a fire and crash rescue station. Hereafter, throughout the thesis the classification of domain is used in preference to case.

The decision to research across multiple (three) domains, selected with a nominal theoretical replication logic, was closely allied to the use of grounded theory as the core approach to data collection and analysis.

3.4.4   Using grounded theory

Grounded Theory is a general research approach developed for largely behavioural science applications by Glaser and Strauss (1967). For different researchers, it may be used as a strategy (a general plan of action) or a methodology (found on specific philosophical inclinations) or a method (of data collection and analysis). It was clearly the intention of the authors that it represented a meta-theory in itself - that theory can be developed inductively from a corpus of data – and their key contribution was to identify a research approach in which the emerging theory fits the data. In this endeavour it is fundamental to their approach that research in the grounded theory tradition focuses on case (domain) rather than variable data. Indeed, it is not unusual for more than one domain to be explored in a single piece of research (Eisenhardt, 1989; Locke, 2001). The logic here is that, by selecting domains with theoretically discrete characteristics we might identify different outcomes from similar characteristics or similar outcomes from differentiated characteristics. This concept was also fundamental to my approach.

Some years later, in a more rigidly proceduralized variation, Strauss and Corbin (1990) proposed a set of methodological steps, careful execution of which would in some sense guarantee that good theory emerged. The logic here appears to be that the process by which a theory is constructed is the best guide to its quality. Thus detailed systematization improves validity and that produces better theory. This point remains moot. While it is generally held that good theory emerges from rigorous and disciplined research (Blaikie, 1993; Easterby-Smith, Thorpe and Lowe, 1999; Locke, 2001; Whetten, 1989), these same authors support the view that the process of generating theory is ultimately less important than a theory's ability to explain data.

Indeed, Glaser and Strauss have progressively diverged in their articulations of grounded theory with Glaser (1978, 1992, 1995, 1998, 2002) mounting ever stronger defences of his original emergence concept seeing Strauss's more proceduralized development (1990, 1997) as forcing, within a quasi-deductive perspective. Their different views are not wholly incommensurable, not least because they have a common foundation in the original collaborative work. However, Glaser contends that the product of grounded research is intended to be what he terms a transcending abstraction rather than a precise description (2002:1). He suggests this abstraction (from time, from place and from people) frees the researcher from the usual focus on accurate description and puts at the heart of the study the development of concepts that fit and are relevant (grounded). I am personally persuaded that the inherent flexibility of following Glaser's approach is preferable to Strauss's more proceduralized articulation. As a consequence I focus on the Glaserian approach hereafter.

My approach is further informed by the Guba and Lincoln (1988) view of grounded theory as an interpretive method of naturalistic enquiry. Following their view, in this case the purpose of study is to uncover how responses are configured rather than to identify those that are archetypal in any sense of necessary. The aim is to demonstrate proof of principle rather than to produce a predictive model, in an approach that seeks a conceptual model generated by creative induction rather than by logical deduction from prior assumptions. The approach is also eclectic rather than purist because it embraces four conceptual perspectives; it is naturalistic, heuristic, holistic and inductive.

By way of explanation, this approach is naturalistic in that it is concerned with the study of processes as they occur rather than on the basis of pre-determined and expected outcomes; it is heuristic, in that it is uses continuous redefinition to allow an increasingly comprehensive understanding of processes to emerge; it is holistic in that it offers a spectrum of possibilities rather than a delimited set of predicted responses, and; it is inductive in that it abstracts instances into a more general pattern, unfettered by predetermined expectations or benchmarks.

3.4.5   Collecting and analysing the data

Uniquely, at the heart of the grounded method lie the conjoint practices of collection, coding and memoing during analysis and theory development in an end-to-end process (Glaser, 1992). It assumes that the theory is concealed within the data and that suitable iterations of coding, memoing and analysis will reveal it (Dick, 2002). It is therefore misleading to take any essentially linear explanation of the process as being

representative of what actual happens. Especially, the grounded concept both requires and enables theory to develop progressively throughout the study rather than as a discrete process, after collection and analysis, as the final stage of a study. Thus, while descriptively we can be specific about what each sub-process involves, thereafter as a course of action each is selectively combined with the other in a highly iterative process that is guided by what seems to be important to the emerging theory rather than any prescribed order.

This view is echoed by Stern (1980) in Glaser (1994) who explains it as a continuous development of categories as clusters of codes, concept development through reduction of categories with selective sampling of data and literature, identification of core categories, concept modification and integration through memos. For me as the researcher, what was important was not that the process elements should be followed in a quasi-linear fashion but that I was aware of with which element of the process I was dealing at any time.

This whole approach is encapsulated in the two most fundamental and distinctive features of grounded theory: constant comparison and theoretical sampling (Glaser and Strauss, 1967; Glaser, 1992). In the early stage of research constant comparison involves comparing data set with data set to allow theoretical categories to emerge. Subsequently, new data sets are compared with the emerging theory. This comparative process is guided by theoretical sampling, which involves maximizing, and minimizing differences and similarities within domains and between them. This purposive sampling process initially increases the range of possible categories but subsequently aids reductive identification of the most relevant strengthening the emerging theory by refining the categories (Dick, 2002). So for example, in this study while the first episode of collection was informed almost solely by the research question, subsequent episodes were increasingly informed by the coding, analysis and theory that had emerged from its predecessor.

Throughout, collection focused on the accumulation of data from interview and archival sources. As the prime method of data collection I used interview of informants with broad experience in the practices of their domain. However, I set these against several periods of prior observation in order to become fully engaged with each domain (Johnson and Harris, 2001), to explain my research to prospective informants and thereby to create trust and confidence in purposes and methods (Harrison, 2001). This mutual orientation period was purposely kept separate from the formal data collection since I was ultimately more interested in grounding the research in informant reports than in adopting a more ethnographic observational approach to interpretation (Singh and Dickson, 2001). In addition, and with a similar logic, I took advantage of access to a range of archival material.

Since archival data represent a permanent record available for later analysis, in so far as interview data was concerned I opted to record each interview such that they too could be analyzed continuously. Glaser (1998, 1990) advises against this, and indeed note taking, during interviews for the experienced researcher, recommending a focus on the informant's words as they are spoken as the basis of subsequent note making and reflection. He proposes that the focus of attention is patterns of behaviour rather than

details within the data. However, I judged that for the purposes of a thesis I would have been vulnerable to missing important data and so I audio taped the interviews (each of between sixty and ninety minutes duration) and personally transcribed these in order to have a permanent record.

This process held several advantages in that it increased opportunities to review data and perhaps discover important issues that may have been missed in the initial conversation and, by repeated reading and listening, progressively increased my sensitivity to what informants considered important and therefore what avenues of enquiry to follow subsequently. It was also useful for monitoring my interview technique.

Coding involves identifying thematic categories that emerge from the data and any properties or attributes these categories appear to embrace (Glaser, 1992). It is also likely that dimensions of these properties will emerge either directly from the informants words as in vivo descriptions or through subsequent speculation by the researcher (Dey, 1999; Partington, 2000a) as enrichment for the basic categories. Over time the categories are likely to reduce to a single core category that captures the fundamental phenomenon under investigation augmented by a small number of other categories that constitute the solidified theory.

While coding, it is also important to make memos and to identify useful direct quotes. Memoing involves short reflective theoretical soliloquies on what appear to be significant emergent concepts that are progressively refined until the memos, suitably arranged represent the framework of the theory for write-up. Direct quotes are data fragments from interviews where the words of the informants provide the supporting evidence for theoretical concepts enshrined in the memos. The more extensive the memos and quotes are the more comprehensive and compelling the final theory is likely to be (Dick, 2002).

Although a number of specialist software packages have become available for analysis of qualitative data (Atlas, NUD.IST, NVivo, QSR) they tend to support content rather than grounded analysis (Johnson and Harris, 2001). I found that early attempts to use them constrained the essential creative process fundamental to Glaser's (1992) concept of the grounded approach. The word processing capabilities of Microsoft Word (e.g. track changes and word search) had a freer form and proved much more amenable to my personal approach. This was supported by extensive use of index cards, which could be easily carried and arranged for developing and refining categories, properties and memos; a technique that Glaser (2005) continues to recommend in spite of the proliferation of computer based tools.

Overall, I took Glaser's advice to seek conceptual categories from relatively large amounts of individual interview data (Glaser, 1992). Although initially it was difficult to employ this technique, because I found it difficult to identify what was important, as the research progressed my guiding approach to analysis was to identify what general theme was emerging from a segment of an interview and to then track specific quotes that warranted the category rather than building high level categories from agglomerations of lower level ones. I also took his advice to seek a core category,

39

which could preferably be expressed as a gerund (e.g. negotiating, dying, educating). However I shall delay revelation of the core category in this study until later in the development of the theory.

As the analysis progressed my developing theory informed the direction of subsequent enquiry so that new instances of data supported or challenged extant categories or identified new categories (attributes and dimensions). Helpful in this regard was the use of a paradigm model. The use of such a model is strongly recommended by Strauss and Corbin (1990) in their highly systematized approach to grounded theory and therefore stands somewhat at odds with my preference for Glaser's (1992) less prescriptive approach. However, as Partington (2000, 2001a) demonstrates it is possible to follow the concept behind Strauss and Corbin's (1990) formulation but to simplify the model by reducing the elements from the eight they identify to just three: Stimulus, Organism and Response (S-O-R), a model that reflects the symbolic interactionist origins of the grounded approach. This S-O-R model connects the notions of stimulus and response via a mediating organism; that is to say an intelligent cognitive process. It provides useful initial locations for data without predicting specific relationships, causal or otherwise. Working with this as a model also provides the three initial high level categories of Stimulus, Organism and Response and codes of [S], [O] and [R]

To illustrate these processes I include below a data extract from one of the interviews which includes coding for categories, memos and quotes. This extract comes from the first domain of study (A&E) and an early interview with the consultant surgeon.

> At the heart of our craft are the knowledge and skills we acquire from our formal professional medical education, practical training and continuous professional development [O-EDUCATION AND TRAINING-FORMAL]. This includes extensive study of medical sciences and includes medicine, surgery, pharmacology, anatomy, physiology etc [O-KNOWLEDGE REQUIRED-BROAD]. Also we need to understand what rules and procedures have been developed to guide the application of these various kinds of knowledge within our chosen specialization of A&E [O-RULES AND PROCEDURES-GUIDANCE]. Essentially this is general medicine [O-SKILLS REQUIRED-GENERAL] with a focus on the resuscitation [R-TREATMENT-RESUSCITATION], assessment [O-UNDERSTANDING-ASSESSMENT] and further treatment of acute illness and injury [S-PRESENTATIONS-ACUTE] in patients of all ages so that they can either be discharged or admitted to other departments [R-DISPOSAL-DISCHARGE] [R-DISPOSAL-ADMISSION]. It also includes familiarity with the equipment that is available within the department [O-KNOWLEDGE REQUIRED-MATERIAL RESOURCES], everything from a scalpel or suture needle, drips right up to the defibrillator and a whole host of other stuff [O-RESOURCES-COMPREHENSIVE]. The reason of course is so that we can cope with whatever turns up [S-PRESENTATIONS-UNSPECIFIED] often with little or no notice so we need to be able to respond quickly and appropriately to the expected [R-STYLE-RAPID] [R-STYLE-APPROPRIATE]. Mostly that has at least as much to do with intuition and judgment rather than just application of formal knowledge however skilled [QUOTE] [O-JUDGMENT-INTUITION] [MEMO-PROCESS MAY HAVE MORE THAN ONE COMPONENT. SOMETHING TO DO WITH PREPARATION AND APPLICATION OR KNOWLEDGE AND ACTION?].

This example from an early interview demonstrates the density of coding that is typical at the beginning of the grounded process when what is important is not yet clear and so many comments are coded. As the process unfolded, this density reduced markedly as the significant categories were identified and subsumed earlier categories.

In the example the coding illustrates the use of three high level categories applied to instances within the data: S for Stimulus that is the events to which the A&E staff respond; R for Response, that is the kinds of response they make, and; O for Organism, that is the processes that connect stimulus with response. Each is qualified by a sub-category (or property) and perhaps further by a dimension or short description. I have identified a possible QUOTE regarding the intuitive rather than rote application of knowledge and a MEMO that this informant seemed to be describing a mechanism that had two components, one to do with preparation or knowledge and one to do with application or action.

By using square brackets, uppercase and consistent identifiers (S, R, M, QUOTE, MEMO) I isolated and made easily identifiable what are codes, quotes and memos as well as facilitating easy search and recovery, using the 'Find' facility in Microsoft Word.

This process continued until I achieved theoretical saturation. In grounded research, data collection, analysis and theory development are not separate and sequential processes. Thus the time to stop is when it becomes obvious that analysis of data has diminishing returns and is most often recognizable in two particulars (Dick, 2002). First, nothing new is added to what is already known about a category and its properties and second, no new categories are revealed, or as Glaser and Strauss (1967) suggested, the process has become repetitive, indeed monotonous, and further analysis is redundant. This point is identified in the body of the thesis.

3.4.6   Conclusion

Central to the grounded approach to theory development is the iterative and reflective reading of interview transcripts, field notes and archival material in order to discover categories, properties and dimensions that emerge from the data and to speculate on interrelationships. The traditional disjunctions between data collection, data analysis and theory building evident in other approaches remain conceptually discrete but become inextricably related elements in a continuously repeated process. From this, increasingly precise descriptions and explanations emerge to the point at which the introduction of new data fails to change the theory. Glaser and Strauss (1967) refer to the ability to identify these categories, properties and dimensions together with their relationships as *theoretical sensitivity*.

They suggest that this sensitivity is the product of a thorough knowledge of the field of research, immersion in the data and the application of that most important of all research skills – intuition; a view that gains support even from the academic fields of logic and mathematics. For example, Turing (1936) proposed that intuition consists in making spontaneous judgments that are not the result of conscious trains of reasoning but which can be warranted by the data. He went further to propose that this might

include the exercise of ingenuity, or the suitable arrangement of intuitions. Glaser, although a researcher trained in the formalisms of quantitative sociology, had notions like this in mind when he was 'discovering' Grounded Theory. In Glaser and Strauss' initial monograph (1967) and Glaser's subsequent descriptions, this approach was seen as preferable to the rigid following of procedures, not least because the quasi-linear representation inherent in any articulation camouflages a much more iterative indeed messy process, to which procedures add little. I found this open intuitive approach most conducive both to my personal perspective ad to the context and domains of research.

CHAPTER 4

RESULTS FROM AN ACCIDENT AND EMERGENCY DEPARTMENT

4.1   Introduction

In this chapter I present the results from the first study domain - the Accident and Emergency (A&E) Department of a National Health Service (NHS) Trust Hospital in the North Midlands of England. I begin in Section 4.1 with a short introduction that includes an overview of the general A&E environment, as described by the NHS and professionally informed by the Faculty of Accident and Emergency Medicine (FAEM) of the Royal College of Surgeons (RCS), followed by some more detailed background on the focal department. I then outline data collection and analysis methods in continuation of the methodology described in Chapter 3. In Section 4.2 I present examples of the data I gathered to support a descriptive narrative of the A&E domain, from which I develop initial constructs that relate to the events that clinician teams face, the interventions they make and mechanism by which teams in this domain configure their interventions.

4.1.1   Accident and Emergency as an area of clinical expertise

Accident and Emergency Medicine is the discipline concerned with the provision of immediate care to the acutely ill and injured. It focuses on the resuscitation, assessment and treatment of acute illness and injury in patients of all ages by appropriately trained and experienced staff. The service is available continuously 24 hours a day and is Consultant led. Typically, the service deals with patients with one or more of the following conditions: trauma, usually within two days of injury; pain, unrelieved by simple analgesia; acute illness; respiratory distress; change in mental status, including alteration of consciousness and acute confusional states; patients brought to hospital by emergency ambulance or the police or other response service; patients appropriately referred by any other health care professional. In addition, the A&E department will generally lead the clinical arrangements for dealing with a major incident. Increasingly, with the upsurge in the threat of terrorist action, departments are developing the ability to deal with chemical and biological incidents.

In these units work is of a high intensity, the volume of work and the type of patients are largely unpredictable and therefore those working in A&E medicine have to be able to make rapid decisions often on limited information. It is the only hospital-based specialty where a complete spectrum of illness and injury is managed. This requires that A & E clinicians of all grades are therefore generalists in the broadest sense of the term, but they specialize in resuscitation, while a number may also bring with them or develop individual sub-specialty interests.

It is characterized by a complex interaction between precisely articulated procedures and protocols, defined by the Royal Colleges, together with the ability to use considerable autonomy to deal with a vast range of patient presentations. Not surprisingly then, due to the variability of the workload and the speed of response required, it is a specialty that attracts those who enjoy immediate decision-making in demanding circumstances. This is also reflected in some key personal attributes of

A&E clinicians. They are assessed as needing, for example, a dynamic approach, that is taking an active and creative role, and an interest in decision-making coupled with the ability to cope with a constantly varying workload and to act as part of a team.

The foregoing characteristics were elaborated by Benger and Glucksman (2001) and have been formalized most recently in the 'Alberti Report' for the Department of Health (Alberti, 2004) and in the 'Way Ahead' document of the Faculty (FAEM, 2004). Taken together these contributions suggest the need for a mechanism that has the capability to produce a wide a range of configurations, many not directly analogous with the polar dimensions of centralized and decentralized concepts, and all predicated on relevance rather than prescription, is axiomatic in this domain. I have used the word axiomatic intentionally because, as Penrose (2004) notes in his magisterial work on the search for reality, an axiom is a primitive assertion the validity of which is taken to be self-evident. In social enquiry as much as in natural science we are prone to work axiomatically but, as Scruton (1997) suggests, probably with rather more practical than philosophical warrant.

The explicit notion in Benger and Glucksman (2001), of having to deal with the unpredictable, with largely autonomous interventions, makes A&E an excellent domain in which to begin this research, since it captures axiomatically, but without concrete explanation, the phenomenon of interest.

4.1.2 About the Accident and Emergency Department

Note: By working through personal contacts I was able to negotiate access to this A&E department with ease, subject to anonymity for both the unit and the individuals being maintained. Although this is a less than ideal situation in reporting research, the increasingly litigious nature of our society, especially with regard to the medical profession, increases the risk of legal action when direct attributions occur. A senior doctor indicated that while the general administration of the Trust and the department were less sensitive, when dealing with non-clinical research (as in this case) that nonetheless takes place in a clinical environment, direct attributions with regard to patient presentations, staff activity and treatment were highly sensitive and the department required that it was avoided. Indeed, even in clinical journals reporting specific clinical interventions, direct attributions are often avoided for not least of which reasons is the primacy of the topic rather than the identity of patients or clinicians. Research based articles in clinical journals will tend to concentrate on diagnosis, treatment and outcomes on a case basis avoiding direct attribution to hospital, patient or clinician. In order to secure free access to the department and to avoid the need for legal perusal of data or active censorship of material, I chose to accede to their request. Even though I willingly discussed my data and findings with informants both to check for precision and to increase the consensual validity of the study, my judgement was, and remains, that a fuller and freer picture of the activity of the department emerged by allowing for anonymity.

The A&E department that hosted this initial study is in a large city-based NHS hospital in the North Midlands. Although there are other large hospitals in the city, because of local health authority brokered agreements between them, this hospital is the specialist A&E provider. It deals with approximately 80,000 cases each year, coping with

everything from minor injuries to providing in-house and outreach support for major incidents such as multi-vehicle traffic accidents, industrial accidents, major sporting events. It also has contingency plans for dealing with incidents at the local airport and for responding to terrorist action. The department is extremely well equipped with leading edge technology and highly qualified staff in clinical, technical and ancillary functions. The staff is divided into shifts each of which has a similar cross section of clinical, technical and ancillary functions represented. Typically, a shift will include one or two consultants, two specialist registrars, three senior house officers, two house officers and two emergency nurse practitioners as well as additional nursing, technical and ancillary staff. Shifts can last up to twelve hours.

Beyond the nominal shift, it is in the nature of the domain that there is no team or task that can be readily identified in advance. Teams form round tasks, rather than being preformed and the tasks of interest to this study are patient presentations, single or multiple. For clinicians, a presentation is a patient arriving at the department with a condition defined by its signs and symptoms. Each presentation therefore places its own particular demands on the resources of the department and so the number of clinicians and other workers involved, similarly the type and quantity of equipment needed, varies on a presentational basis.

The notion of team in the department is therefore synonymous with the swift starting concept (McKinney *et al*, 2001) in which team members are familiar with each other on a professional basis, and are co-workers in the same department but they may have relatively limited history actually together. Even when they have a significant history, a presentation may be so far outside their collective experience to make resolution less tractable. Yet they must perform at a high level of effectiveness very quickly in high stakes environments with human life depending on their ability to perform. There is no time for the usual teambuilding process, except insofar as it develops progressively over time-spans much greater than individual presentations. To take one example, forming, storming, norming and performing (Tuckman, 1964), such as they identifiably occur, must take place coincidentally and instantaneously with the presentation, somewhat diluting the potency of Tuckman's insights when applied to this domain. As a consequence, rather than make what I judged would have been a futile attempt to identify or track teams, I chose to focus on presentations. As a particular benefit, given the volatility of the environment, I believed that this would give me the best opportunity to understand how these ad hoc teams would form, augment and disband and thereby reveal the configuring processes, in use.

4.2   Data collection and analysis.

I researched in the department between 1 Oct and 9 Nov 2002, allowing me to interview clinicians on their home territory and at first hand. During my orientation period I was allowed to roam freely about the department but I chose to watch individual cases from arrival until the patient had been stabilized and admitted, or treated and discharged. For interview I spoke with a cross section of ten members of the clinical staff who were most directly involved with patient treatment and who had freely volunteered for interview. My key informants are shown in Table 4.1, below.

Informant	Code	Role
Consultant	CON	Senior doctor who has completed all of his or her specialist training is on the specialist register in their chosen specialty and heads a team of clinicians
Specialist Registrar (x2)	SpR1 SpR2	Surgeon with least 2 years experience who has passed higher surgical training and is receiving advanced training in a specialist field of medicine in order eventually to become a consultant
Senior House Officer	SHO	Basic surgical trainee undergoing 2 years specialist training prior to registration
House Officer	HO	Medical graduate who has received a medical degree and is receiving further training, while caring for patients under the direction of the senior staff
Cardio-thoracic Surgeon	CTS	Senior doctor specializing in the surgical treatment of diseases and injuries that affect organs inside the thorax (the chest)
Radiologist	RAD	Senior doctor who specializes in interpreting images of the body, such as x-rays and ultrasound scans to diagnose diseases and injuries
Emergency Nurse Practitioner	ENP	Senior nurse who is responsible for autonomous clinical decisions in diagnosis and care management and who may refer or discharge patients
Triage Nurse	TRN	Nurse who assesses the seriousness of patient condition and ensure that the most seriously ill patients are treated first
Ward Manager	WDM	Senior nurse responsible for quality of care and leadership of the ward team

Table 4.1   Key informants

I conducted ten interviews, averaging 75 minutes duration. The interviews were conducted off-shift so that they would not compromise the clinician's ability to respond to the immediate and unpredictable nature of live events. The interviews had a loose structure to reveal informants' subjective interpretations (but explored the three main issues: the types of events to which they respond during their work, the types of interventions they make and the process by which they produce the interventions.) Data on these three subjects took various forms, including information freely volunteered by informants, such as '…*when that happens what we tend to do is …*' or '… *sometimes there just isn't anything in the book which relates directly to what is in front of you…*' and responses to questions of clarification, such as '…*what would be an example of that?'* or '*how would that work in practice*?'

I also undertook a total of 26 hours of non-participant observation. This observation served largely as orientation rather than as an ethnographic source of data. However, I kept short field notes to act as reminders and as provocation for interview enquiry.

4.3   Domain narrative

In this section I develop a domain narrative derived from the interview data. The narrative represents the distillation of the open coding process and illustrates how the key themes emerged illuminated by verbatim data extracts. Since the narrative represents an abstraction of field data it is therefore necessarily selective. However, the

commentary and data extracts identify the key themes that emerged from the coding process and represent the issues that the informants find most important and challenging in their work.

The circumstances with which an A&E department is intended to deal fall into a range of categories that have trauma related attributes. These categories are not only clinically precise but also feel intuitively 'right' to the layperson. An early indication of this came from the lead consultant in the department.

> 'Examples of the sort of thing we are set-up to deal with include: heart attack, chest pain, unconsciousness, heavy bleeding or blood loss, broken bones, deep wounds such as stab wounds that may affect internal organs, severe breathing difficulties for whatever reason and a variety of head injury because that can have very serious consequences while being almost asymptomatic.' (CON)

Presentations, the arrival of patients in the department, can be represented by type and number in the statistics of post hoc reporting and probabilistic ante hoc forecasting with some precision. But, this simple representation masks the level of turbulence and uncertainty actually experienced by staff. For example:

> 'On average NHS Accident & Emergency (A&E) departments throughout the country will treat between 30,000 and 35,000 people per day.   But this daily average has a fair number of peaks and troughs throughout the year. For example, winter is about 15% higher than summer and public holidays can produce spikes as well. Nationwide there will be substantial variations between different areas because of local conditions like cold weather spells, demographics and increases in illnesses such as flu, or major events, like a Marathon or rock concert. Here, using the same averaging approach, we treat about 220 a day, that's one every six or seven minutes. Again that is subject to spikes so we rarely have the luxury of a steady flow. Also of course we don't know really from one minute to the next what the symptoms or urgency of the next patient will be.' (CON)

It also masks a work-load addition that comes from inappropriate presentations at A&E units by patients whose condition fits neither specific classes of A&E condition nor more general characteristics of trauma or urgency.

> 'One major inconvenience is the number of people who think that A&E is an alternative to their GP. Or that our people are more experienced in dealing with medical problems than a GP might be. It seems to be based on a misunderstanding between a GP as an expert in general medical problems, what most patients have, while A&E doctors and staff specialize in accidents and emergencies, what many patients have not had. Some think that it is OK to visit A&E just because their own doctor can't see them immediately, or that calling 999 for an ambulance gets them priority attention. In here all patients are seen on the basis of medical need, assessed by triage, not how or when they arrive at the hospital or the absence of GP cover.' (TRN)

However, the experience of all of the informants who deal with trauma tended to confirm that, across the NHS and within individual units, qualitative (types of presentations) and quantitative (numbers of presentations) forecasts, *inter alia*, are used to form the base line of planning and resourcing.

'A&E departments are set up really to deal with trauma of one sort or another; that means being able to deal with the unexpected. What actually arrives at the front door falls into fairly predictable groups, perhaps of varying severity or requiring varying speed of response. A fracture is a fracture, a laceration is a laceration whether you get them playing soccer or being booted or bottled by an opposing fan or in a vehicle accident, Saturday night or Tuesday morning, with single or multiple presentations. So in the broadest sense our work is fairly predictable and we have protocols to deal with cases.' (SpR1)

It is further evident that the more often a presentation is, or has historically been, experienced the more it influences statistics, forecasts, the knowledge base and skill development.

'Many of the presentations we get have been seen many times before and so we have been able to build up a pretty clear idea of their signs and symptoms, from lacerations to heart attacks to drug overdoses, and you learn those at medical school. Of course, when we encounter novel or rare presentations, unique combinations of condition or strange allergic reactions etc., we won't have developed such clarity. But the more prevalent they become, the better we get to know them and they become part of the overall fund of knowledge, both within the department and by direct communication or publication within the wider trauma community. (SpR2)

However, procedures and protocols aside the majority of presentations in A&E have characteristics that diverge quantitatively or qualitatively from characteristics for which these procedures are designed. The range of divergence varies from really quite marginal to unequivocally extreme. Perhaps the most simple and obvious, though not trivial, of these divergences is the individuality of patients

'Most presentations fall into quite easy categories, but of course, even if the injury or condition is pretty standard, each individual is different and will respond differently, both physiologically and psychologically, to treatment. So in that respect every case is different. An elderly woman with osteoporosis who presents with a fractured tibia is a different proposition from a young healthy footballer with a similar injury. Although little old ladies tend to be less trouble.' (TRN)

Furthermore, the manner in which a case evolves from its initial presentation symptoms might also tend to draw it away from more obvious characteristics.

'What starts off as an apparently simple case can develop in a variety of different ways and so you have to be alive to changing signs and symptoms and the new possibilities for diagnosis or intervention that they indicate. We had a passenger from a minor car crash with a dislocated shoulder that we thought related to the crash. What I discovered was that he was epileptic and fits can cause dislocations, so rather than an A&E patient as a result of the crash he was better dealt with by our orthopaedic department as a repetitive dislocation.' (ENP).

But the divergence between presentations that are, largely if perhaps only statistically, provided for and actual presentations can become extreme, for example in uniqueness, severity, velocity or error sensitivity. It follows that, as the divergence becomes

increasingly extreme it retains a decreasing, if indeed any, connection with previously experienced stimuli.

> 'Some time ago I went out with the paramedics to a serious RTA (road traffic accident). The driver was trapped in the car with a fence-post through his chest. He could hardly breathe and was haemorrhaging badly, in deep shock with massive injuries. We couldn't get him out of the car with the post in his chest and we couldn't get the post out of his chest while he was in the car. If we didn't get the post out of his chest he would die, soon! In the unit we would have been hard pushed to deal with him, in the car there was no precedent in my experience. (CTS)

Given that A&E staff face a broad, and sometimes bewildering, spectrum of cases, the challenge is always to match clinical, and indeed non-clinical, responses to the stimuli of traumatic presentations. Grounded in the long history of medical science, as influenced by the quantum advances made in recent years, many of these responses are described in the rules, protocols and procedures of trauma care.

> 'It is for those predictable, routine presentations that we have procedures. My first thought is always this condition or injury involves this clinical procedure. But we have to use our discretion; it is something we depend on in all forms of medicine, perhaps more so in trauma care, but for a lot of the work, even in A&E, we often can conform to procedures. A lot of work has gone into developing them. They work and the best of them, perhaps not all, are economical with time, effort and resource. But you cannot get away from the fact that you have to treat the case as it presents itself to you – just following a procedure will not be enough.' (SpR2)

Accordingly, while the working environment in A&E is based on well developed, evidence-based procedures and protocols developed by the FAEM, comprehensively supplemented by similar guidance from other Royal Colleges and Faculties (e.g., nursing, radiology, anaesthetics) they appear to represent lower level aids rather then high level prescriptions. Quoting some examples:

> 'A 32 year old male presented with a chest stab wound from a fight in a pub that we decided required a tube thoracostomy, that's a drain. There is a procedure for administering the drain and a supplementary for giving prophylactic antibiotics to reduce the chance of intrathoracic infection. But you make the decision as to what is needed.' (SpR1)

> 'A 24 year old male presented with a gunshot wound to the left thigh. Examination of the leg revealed a through and through wound with no bone, nerve or major vessel involvement. The choice is essentially between basic entry and exit wound cleansing and more radical surgical debridement - with procedures for both. In general, simple soft tissue gunshot wounds without any complications like bone, artery or nerve damage factors can be managed with minimum wound debridement and antibiotics. You use your discretion to decide what is appropriate and then follow a procedure if there is one.' (CON)

This emerging theme of the need to use discretion explicitly and frequently intervenes, often at an early stage, although the divergence may be marginal and temporary leaving procedures unaltered in their basic format.

'When I think back over most of my medical career, and certainly in A&E, two things seem clear. The first is that in many of the interventions I have made, I have been following a basic procedure but in most of those I have also done something a little different from the other times. Nothing major and not worth changing an essentially good procedure for. Just something about the specific case led me to make a small change, a variation in the strength of a drug or amount of an antibiotic, a repeat of a test, leaving a wound to knit rather than use sutures.' (SpR1)

Some of these changes can be taken up on a more permanent basis and may feed back into local or universal replacement or modification of a procedure, at least insofar as offering another treatment option is concerned.

'Analgesia is one example. Pain relief is important and had become an early default. But we found that with back injuries for example, provided the patient is immobilized, and not in excruciating pain, it helped us to delay analgesics so that we could get active cooperation in diagnosis. So now, as a matter of course, delaying analgesia is the default. The additional discomfort for the patient is normally quickly offset by the improved diagnosis, selection and administration of better focused treatment. Of course, if the patient is in real discomfort we will administer analgesics. So even when we change a procedure, we apply it with regard to the patients needs.' (CON)

In developing their responses, clinicians also find it practical to assemble responses from an agglomeration of whole or part, lower level procedures, not routinely applied in any specific or proceduralized way.

'Sometimes you may have a high level procedure for dealing with a general case but some things either you can't do or don't want to do because of the particulars of the presenting case. What you may well have is a number of lower level options within the high level procedure or protocol from which you can choose. An easy example would be trauma principles: A – airway, it must be unobstructed. B – breathing, the patient must be breathing. C – circulation, blood must be circulating. These last two may be natural, or assisted. Then you can get on with treating other injuries – immobilizing fractures, controlling haemorrhaging, treating burns, or whatever. But what you actually do will need to be made up from the options available in each category. endotracheal intubation, ventilation, CPR, defibrillation; clamp, ligature, direct or indirect manual pressure; suture, staples or glue; keep warm, saline drip, drugs; immobilize fractures, cover burns, compress inflammations, administer anti-inflammatory drugs. The options and combinations are almost endless. So what you are doing is making up a treatment regime that accounts for the particulars of the case, from known and established procedures, none of which is specifically mandated. There are much more complex and technically difficult examples of the same thing but the principle is the same.' (SpR2)

Extreme circumstances may call for extreme measures. In highly unique circumstances responses may need to be full improvizations based on first principles of fundamental clinical and even non-clinical disciplines. Reporting on the treatment of a severely injured car driver impaled on a fence-post that effectively jammed him in the wreck of his car, one surgeon related the following example.

'We had to do everything back to front. Try to keep him warm and give him a drip for shock while we tried to get him out. I will spare you the details but getting him out

increased his injuries and the haemorrhaging and his breathing deteriorated. How we treated him, in the car and outside, depended on all the fundamental principles of medicine, with not a procedure to help. But because you know anatomy, physiology, biology, pharmacology you can do something rather than nothing, even making his condition worse, which we did, but increasing his chances of surviving until he is in the ambulance and then in the unit. Now that doesn't happen often in the unit, there is so much more expertise and kit about. But with this guy, once he was in and we had thoracic surgeon, cardiac specialist, renal specialist, orthopaedic surgeon, nurses, technicians, anaesthetist and all the kit you could name and still we were working from first principles because that kind of trauma isn't in the book. The guiding principle is to treat in order of priority the things that are most likely to kill the patient.' (SpR1)

This notion of prioritizing is a formal procedure within the department where the prioritizing of treatment is achieved using the triage system, which is the sorting of casualties by priority of need. Thus the first come first served notion that some patients assume, is actually a most needy first served process. The triage system, now universally employed in A&E departments, is based on a number of assumptions and has its own procedures, clearly and briefly explained by the triage nurse.

'If we have got a large number of casualties we need to prioritise their treatment management. It began by sorting the dead from the dying, and the no-hopers from the hopers on the battlefield. We use a similar process. A less extreme version, but the same idea, to do the most for the most, is used. As triage nurse, I do the prioritizing but do not get involved in the treatment. I put the patients into categories and colour code them. So, a Priority 1 (P1) is life threatening, coded red, that means immediate treatment and an example would be tension pneumothorax. Fractures would be P2, urgent, yellow. Minor injuries perhaps a sprained ankle say, P3, Green, delayed. Dead on arrival is P4, white. We can use some pretty simple initial methods like can they walk unaided, is the airway clear, is their respiration regular, what is the pulse rate, but we may use more advanced diagnostics when things become more complex. Pain, except as an indicator of some other trauma, is not a key indicator. We get some real babies with only minor injuries.' (TRN)

But even here the procedure does not determine outcomes; it merely serves to facilitate decisions. Once the prioritization has been done the treatments available to patients are numerous. However, it is important to keep in mind that A&E departments exist to rescucitate and stabilize very serious cases and to deal as expeditiously as possible with lower priorities. Also, assuming that facilities are available within the hospital, or at a sister hospital, the A&E patient will be admitted or, if in no need of admission, discharged as soon as is possible. Either way the intention is to release patients from A&E as soon as is practical. The way in which this is achieved combines a number of elements. Perhaps first among these is the professional knowledge and skills of the staff.

'In general it is important that you stick to what you know and nobody knows everything. That's why we have teams - nurse, radiographer, anaesthetist, surgeon etc so we can use each other's special knowledge. Of course, we all know something of each others' jobs so we can pool that when the unexpected arises rather than just insist on being a nurse or an anaesthetist or a surgeon or whatever. A nurse will normally do prep, insert drips, take samples for tests, generally assist the surgeon. The anaesthetist will concentrate on passing gas and monitoring patient status, while the surgeon treats

the injuries. But a nurse being able to operate the anaesthetic rig or the anaesthetist being able to do minor surgery if the unit is busy can be useful.' (CON)

As previously noted, much of the work of the department, essentially the ways in which the clinician's knowledge and skills are put to use, is performed within a framework of well designed, evidence-based rules and procedures. In general rules state what is or is not considered acceptable while procedures give more detail as to how the rules may be implemented.

> 'We have rules from the Royal Colleges, from the NHS and from the Trust for everything from what is ethical practice, to what qualifications we require and hours we can work, to what expenses we can claim, and we can't know them all but we are expected to obey them. The procedures for administering medication for instance, especially by drip or injection, are quite explicit and it is foolish to stray from the procedures, to do so may result in severe consequences for the patient including death. Ethical or other occupational rules might influence the appropriateness of otherwise practical responses. What quality of life does this outcome imply? What are the patient's specific wishes or instructions? More ethically sensitive are things like when a blood transfusion will save life, is the recipient opposed to transfusion on moral grounds? If a surgical abortion will save a mother's life or improve her condition, is the mother opposed to abortion?' (SHO)

However, given the unpredictability of the environment and the wide spectrum of variation in presentations, the clinicians are also allowed considerable discretion in what they do. Indeed, the autonomous application of their knowledge and skills is essential, always provided that they compromise rules or diverge from procedures only so far as is warranted by the circumstances.

> 'One rule is that we are not supposed to administer transfusion without patient or responsible permission, but if life is endangered we can make a decision on our own to work contrary to the rule but we still have to answer for our actions. But you are very circumspect about doing it. Some procedures allow for more flexible ways of doing things. I suppose that when we are not following procedures, we are improvising. Because of the unexpected element in our work we can do that with a fair amount of autonomy but it important to know the difference and to stay as close to the procedures as you can.' (SpR1)

Of the sum of knowledge available in the department, a proportion is embodied in the technological artefacts available to the clinicians. Increasingly the environment is one of complex, leading edge technology, the understanding and use of which are themselves demanding. However, even in an environment that uses such technology, the need to be able to revert to first principles and use the aforementioned discretion to intervene with more basic artefacts is ever present.

> 'Most of the things we need today are technologically complex and expensive: defibrillators, ventilators, heart rate monitors, blood gas analysers. We have to justify their purchase and use, although they are increasingly required by national standards of clinical excellence. If we had unlimited funds we could cover every eventuality. But you can resuscitate a patient with anything from complex equipment, like the defibrillator and ventilator, to simple basic methods like external heart massage and

mouth-to-mouth, CPR. Best to have the kit but you do need to be able to go back to basics or improvize if the kit goes down.' (HO)

The ways in which the clinicians work is to form ad hoc teams round tasks. Indeed the trauma presentation will in most cases dictate the urgency and level of response, and so the notion of preformed response teams, except in the very generalized context of the duty shift, is inappropriate. The way these teams work is based on familiarity with each other that builds over time, training and repeated exposure to trauma events which, taken together produce a range of both formal and informal routines. The basic functions of each of the core specialisms in medicine form the first set of routines.

> 'The way in which we approach our work in the department is based on a loose framework of our broad clinical roles. A surgeon is responsible for treatment, a radiographer is responsible for supplying diagnostic support, a nurse is responsible for the general care and well being of the patient, that sort of thing.' (ENP)

However, these functions and roles, important for fundamental division of labour and transparency, become smeared when urgency and/or resource limitations supervene.

> 'There are responsibilities that come with your specialism, the patient deserves to know who is doing what so the way we work together is basically dictated by our jobs. But as you saw when that multiple road traffic accident came in, we were one nurse and one registrar short and one nurse was a probationer. But working together on other cases we had developed an instinct for each other and so you can quickly find new ways of coping with the situation within the team. So a key part of our job is using the combined skills and knowledge of the team often in ways that do not relate directly to formal team functions. As you saw earlier, what was important was to get it right, but be able to change from one procedure to another – fast, which involved changing roles or using different instruments or equipment or drugs. I didn't stand about and wait for a nurse to get an IV in; she was busy so I did it. Continuous talking and adjusting roles and actions to the situation is what it is about.' (SpR1)

Over time these interactions develop an easy familiarity and influence the speed and effectiveness of interventions.

> 'The way we work together is important. There is a sort of buzz when we are busy, what the psychologists call flow I think. Everyone is pretty aware of everything that is going on which means we can triage patients, agree diagnosis, allocate tasks and resources pretty quickly. Knowing the procedures is fundamental, but I doubt you will find two departments or even two shifts that work exactly the same even from a common knowledge base. We all have our own ways of working within a good basic framework.' (SHO)

Furthermore, the combination of individual expertise, experience of trauma and of working together provides the baseline from which interpretation of patient signs and symptoms leads to diagnosis and treatment. The procedures and protocols of A&E cover many of these although interpreting rather than accepting superficially obvious indications is also important.

'My first thought is always that this condition implies this clinical procedure. A lot of work has gone into developing them with technical, ethical and legal implications. But you always have to be careful about making the more obvious diagnosis when an apparently simple presentation may mask a more important factor. I'll give you two very recent examples. About a week a go comatose patient whose breath smelled strongly of alcohol and who had suffered temporary incontinence was reasonably presumed to be in an alcohol induced stupor. All we had to do was to place him in the recovery position, so he didn't choke if he vomited, and monitor him. It is a nuisance because he is taking up much needed space and staff because his condition was not of itself life threatening although could have become so. However, two days ago a chap came in with a dislocated shoulder, having been in a minor road traffic accident. But we could not relate the dislocated shoulder directly to the accident. On further investigation, the nurse practitioner discovered that he was epileptic and sometimes fits result in dislocations so his injuries were not really a direct result of the accident at all but of a fit that may have caused or been caused by the accident. What he needed was not just manipulation in A&E to reset it but elective surgery to stabilize what was in essence a recurring problem. So you have to be careful what diagnosis you make, even when the signs and symptoms seem pretty clear.' (SpR2)

Neither of the above would be seen as critical, although as with all medicine, patients need to be treated with empathy for both the physiological and psychological and even welfare aspects of their condition. But sometimes, confusing signs and symptoms camouflage potentially more acute conditions.

'One guy came in from a car crash a bit shocked and mildly concussed. Then during treatment and for no obvious reason the patient became more agitated and we had to anaesthetize and ventilate him. Then we found a recent scar on his head. Talking to his wife we discovered that it was from a previous head injury that he had self treated. That explained his problem. The after effects of his previous injury, that he thought was minor were now aggravated by his most recent accident. So we gave him a brain scan and found he needed admitting. If he hadn't become agitated we might have missed something with potentially serious consequences' (TRN)

The radiologist explained how holistic assessments are progressively, albeit rapidly, refined until the most credible diagnosis, and therefore treatment indication.

'Trauma victims with multiple injuries present particular difficulties. Especially when examining a seemingly isolated injury, you should be aware of likely associated injuries. So it is important to consider the patient as a whole and not just the most obvious symptom or sign. Of course, if the condition is immediately life-threatening treatment should be started straight away without waiting for radiology to confirm the clinical diagnosis. Two examples of such conditions are a tension pneumothorax and a severely displaced fractured ankle, where the skin is at risk from hypoxia and fracture blisters. The diagnosis of certain injuries is wholly dependent on the clinical findings; the radiograph doesn't provide the diagnosis but excludes other abnormalities. Even if no radiological abnormality is found the appropriate treatment based on the clinical findings should be started.' (RAD)

It is apparent from the above that the approach to diagnosis of single or multiple patient presentations is collegial. However, further evidence suggests that everyone is also allowed an input to proposing and applying treatment solutions, without dysfunctional Chinese parliaments resulting. Two presentations serve to illustrate this. First, a female

pillion passenger had been thrown from a motorbike on the M1 motorway. She had multiple chest injuries to ribs, heart and lungs and the staff were having trouble stabilizing her. The resolution was initiated by a nurse, agreed by a surgeon and the subsequent intervention was decided by a specialist from another department.

> 'My nurse noted that the thoracotomy wasn't having the desired effect and so she suggested that we needed a cardio-thoracic surgeon. I agreed and when she arrived she decided that the crushed ribs, internal bleeding and enlarged bruised heart needed immediate surgery in the theatre. So we all contributed to outcome by focusing on what was happening rather than just following a procedure' (CON)

On another occasion a patient with a serious chest wound was dealt with by two surgeons, the more senior deferring to the more junior, who was more experienced with the particular type of condition.

> 'We had an 18-year-old male stabbed with a knife below the left nipple. His pulse had been 125 with a blood pressure of 110/75. I got that down with two litres of normal saline to 85 and 129/82. His chest X-ray showed pneumopericardium with no other injuries. My inclination was to treat him conservatively but monitor closely. Then suddenly we needed an immediate thoracotomy. Harry could do that so he took over. Once we started working it was essential that everyone was contributing, monitoring, suggesting, no standing on ceremony or ego massaging.' (SpR1)

These jointly arrived at representations that lead to selection of treatment tend to be coordinated by speech. While this is hardly earth shattering as an observation, the notion extends beyond simple verbal intercourse between two people.

> 'We talk a lot. By broadcasting thoughts and intentions, as well as instructions the whole team is kept updated without need for constant rebriefing. Newcomers often just listen for a few seconds to get the drift of what is happening rather than ask questions. Also the expertise of every team member is being acknowledged, used and reinforced.' (SHO)

It appears also that, through this collegial and broadcast approach, presentations tend to generate pacemakers rather than specific leaders. Team members assume transient supremacy over the direction and pace of intervention based on general expertise, familiarity with the case or sometimes simply being first on the scene. These pacemakers may be anyone from a consultant to a junior doctor or nurse and the process may be more or less directive. Referring to the first of the above cases one clinician noted:

> 'With those massive chest injuries we were working under direct instructions from the consultant because speed and therefore coordination was paramount, because he was there, and we were in a situation with which he was familiar and we were not. But he was still open to input from other team members and the nurse was the first to notice that the chest drain wasn't working properly.' (SHO)

As far as actual treatments are concerned, the initial triage process simply prioritizes the order in which patients are seen by clinical staff for treatment. However, once the diagnosis is complete and treatment has been initiated there remains a need to prioritize

the individual actions that will be taken. Some of these have a procedural bias but most require instantaneous judgements.

> 'Once you are treating a patient you deal with things in the order in which they will kill the patient. One example is ABC: airway, breathing, circulation. If you haven't got those three, treating the other injuries is pointless. You get no marks for having a perfectly administered drip and an expertly stabilized fracture with a patient who dies from asphyxiation while you are doing it. Also you go for what works rather than perfection. One colleague of mine kept a guy alive by sticking his finger in a stab wound to the heart, not pretty but effective because the muscle of the heart gripped his finger.' (SpR1)

Fundamental to all interventions within the unit, or at the scene of an incident that an A&E clinician is attending, is the availability and mode of use of resources. Within the unit as previously noted, there is a comprehensive battery of high technology equipment. However, resources can be exhausted (the unit is full), or temporarily unavailable (unserviceable). Absence of a critical resource may require improvization.

> 'What you find is that most of the cases which come in here are in some way routine, we expect them, we are trained to deal with them and we have the resources, from a simple bandage to a full resuscitation trolley. Equipment and procedures are intended to be used in a particular way for example the resuscitation trolley for emergency resuscitation, and that is the way they get used absent overriding reasons to deviate. But I have used trolleys as admission beds, heavy elastic bands as ligatures, staples as sutures. Most of these sorts of things one wouldn't prefer but you are dealing with emergency situations and that is what dictates your actions more than procedural niceties.' (CON)

A further product of this initial study is not itself to do with the mechanisms of rapid response, but seems to be intimately connected with the high velocity and error sensitive nature of the domain. In Chapter 2 I described two of the components of the UHiVES context as high velocity connoting rapid decision/action cycles and error sensitivity as connoting immediate, obvious and unavoidable sequelae. The A&E ward manager was keen to describe the process of continuous improvement that was used.

> 'Last month we decided to rearrange the floor so that the frequent problem of trolley waiting would remain within the unit, but in what at least looked like a private space, out of the treatment area. Using corridors is not only stressful for the patients, but also inefficient for us. We just did that, let the teams know what was happening and made a fairly informal but permanent change. That keeps the patients, the Chief Executive and the NHS happy, but it is not just cosmetic, it works, otherwise we wouldn't bother. We have also recently redesigned the information displays so that we are tracking the most important data, what best contributes to patient treatment, rather than just loads of stuff that may be important but not directly relevant to treatments.' (WDM)

That these were effectively reflective, non-time sensitive or seriously error prone actions suggested that they stood outside the focus of the study. However, this simply masked what on further investigation proved more interesting. Discussing this in more detail the ward manager offered the following insight.

'I think that we stay on top of the job by being aware of what is going on, because it is the fact that the outcomes of our work are immediate and obvious on an almost minute to minute basis, that makes the need for changes, or more likely continuous improvement, more transparent.' (WDM)

Support for this view was universal, and is well represented by one surgeon's observation.

'One of the many attractions of accident and emergency medicine is the wide and varied opportunity for clinical education, largely because the work requires prompt and precise decision making. When you work in this kind of environment you know almost instantaneously if you have been successful or not. If something is an obstacle you have to do something about it, be it clinical, technical, administrative, whatever. Now, you may have to give it some thought before you go changing things but the need is generally pretty obvious. I am convinced that the very rapid feedback from our environment means we can recognize and change a damn site quicker than more pedestrian environments.' (SpR2)

In the foregoing narrative I have presented a distillation of a considerable volume of field data and the result is necessarily selective. The selection is guided by the open coding process that identifies the key themes as they emerged from the interview data and each theme is illustrated by an illuminating verbatim data example.

4.4 Domain analysis

The data and explanations given in the narrative provide evidence for two typologies, one of the types of presentations with which clinicians deal, the other of the interventions they make. In addition it provides the basis for speculation on the attributes of the process by which those interventions are produced.

4.4.1 A typology of presentations

From the foregoing narrative, as illustrated by data extracts, my initial attempt at analysis via axial coding, connecting related coded categories, suggested three archetypes of presentation. These might be understood as: routine, that is to say those that fall within experience and/or expectations; nominal contingency, those that fall outside specific experience and/or expectations but within marginal or temporary divergences; and, extreme contingency, those that fall well outside experience and/or expectations, represent a significant divergence and include wholly unique experience.

While this tentative classification of archetypes certainly captured some general characteristics of the presentations, it proved difficult to identify any meaningful boundaries to each archetype, thus supporting my suspicions regarding the value of archetypes, especially in this setting. In further discussion with the consultant he also found the notion of grouping presentations in this way to be unhelpful since it detracted from the uniqueness of each presentation, which clinicians do not attempt to qualify or quantify in this manner. By way of example he proposed that, as presented, precisely which archetypal form a presentation might take might depend on the qualifications and experience of the clinician(s) involved, or the environment in which it is encountered,

within the department or at an accident scene, or the availability of resources or any other of a large range of variables.

Further inspection of the data however, suggested that the specifiable characteristics of what I initially called routine represent what is essentially an 'ideal type' (Weber, 1947). Here Weber intended that the ideal type should be a methodological tool, and provide a datum against which empirical findings could be compared. He recognised that the ideal type was unlikely to be observed in all its particulars since instances would correspond in varying degrees. However, he also emphasized that the types should be objectively possible in that no particular should make the observation of an ideal type impossible. His approach has a connection with the Aristotelian concept of the excluded middle (A or not-A), which is based on the logic of negatives rather than opposites (Scruton, 1997). It depends for its veracity on the notion that if A is defined, then everything that does not meet that definition is not-A. It follows that the range of variation of not-A with regard to A is practically infinite and is unlikely to lend itself to meaningful archetypal representation.

Further, my informants were clear that in most if not all of their work, for reasons of severity, combination, uniqueness of signs and symptoms together with individual patient profiles and histories, presentations had an unspecifiable element to a greater or lesser extent. By using the ideal type perspective it seemed to me I was therefore not observing a limited range of identifiable and, presumably under a different methodology quantifiable, archetypes. Rather, what was emerging was a single, fundamental ideal archetype, a rational descriptive concept rather than either a definitive specification or an averaged summary of experiences, which was unlikely to be encountered in all its particulars. While evolving precision, through experience, might allow for improvements to planning, the design of procedures, training and resourcing etc., it also acknowledged an almost infinite range of divergence with which rational approaches could not cope. Although superficially illustrative the archetypal resolution was not compelling and on reflection I felt that, beguiled by some powerful early insights, I was forcing the data, a tendency against which Glaser (1992, 1998) so strenuously advises.

This led me to adopt a model of presentations that comprises just two constructs, namely specified (A) and not-specified (not-A), as shown in Figure 4.1. I chose specified rather than predicted because it is possible to predict an event without being specific about its particulars. Also, the data supported the concept (articulated for example by Paulos, 1988) that while post hoc statistical analysis of presentations might allow the unit's work to be probabilistically describable, and therefore to inform strategic decisions on resourcing and training, no presentation was individually predictable and therefore specifiable. Thus evidence born of experience leads to improved description of the signature elements of the probable presentations without being able or even seeking to predict individual presentations.

Element	Abr	Type	Description
Presentation	**P**		A patient event that provokes an initial, or a change of, response from the team
	Ps	Specified	A type of presentation that has been rationally conceived and described, informed by but not the average of previous experience
	Pn	Not-specified	A presentation that has not been rationally conceived and described because of unpredictable characteristics

Figure 4.1   Typology of presentations

Note.   Another type of event that provoked action emerged from characteristics of the domain rather than being a relevant part of the activity under study.   Several informants identified the notion of improvement opportunity. Importantly for the purposes of this study these opportunities while unpredictable were not in and of themselves high velocity or error sensitive. Accordingly they do not form part of this basic typology. However, it was interesting to note that the clinicians and the support staff agreed that their ability to identify opportunities and to make commensurate improvements was at least in part a function of the immediate, obvious and unavoidable sequelae of their high velocity and error sensitive domain. Accordingly, I reserve further reference to this until my comparative analysis in Chapter 7.

4.4.2   A typology of interventions

My initial attempt to codify and categorize the data on types of intervention suggested that archetypes might exist. Axial coding suggested that these might number five, being: prescribed, based on following prescribed procedures; modified, based on limited and temporary modification of referent procedures to meet a short-term variation; reformed, based on permanent modification of procedures to align with regularly encountered events that vary significantly from referents (those for which the procedure was designed); constructed, based on a contingently sensitive (i.e. non-prescribed) assembly of lower level referent procedures, and; created, based on the invention of actions, from first principles, which vary fundamentally from procedural referents.

Again, the challenge of identifying meaningful descriptions and therefore separations between these descriptions either directly from the in vivo data or by theoretical speculation suggested that this initial typology was misguided and was probably as forced as the initial groupings in the analysis of presentations. From the same conversation with the consultant reported in 4.4.1 it emerged that clinicians rarely follow procedures, at least in their entirety. Rather, while they might base their actions on procedures they introduce such variations as the situation warrants in a manner that defies attempts at ante hoc prescription and to some extent post hoc description.

The difficulty with ante hoc prescription is a corollary of the predominantly unspecifiable (and therefore not-specified) nature of presentations. Prosaically, if you do not know what to expect you cannot prescribe a response. The difficulty with post hoc description may be connected with the tacit dimension in knowledge (Polanyi, 1966). As is frequently the case, this simple statement camouflages what remains a problematic concept in the literature.

In much of the literature, tacit represents the opposite dimension from explicit on the continuum of knowledge. Explicit knowledge is most frequently understood as codified and therefore easily articulated and communicated, while tacit knowledge is understood as residing in peoples heads and grounded in experience rather than rubric (Pan and Scarborough (1999).

The debate has its origins in Ryle's (1949) concept of mind, but Polanyi (1966) in his seminal approach proposed that we can know more than we can say, suggesting that there is knowledge that may be inferred to exist, perhaps because of observed behaviour, which nonetheless we cannot articulate. Here he literally meant we cannot say, rather than simply find difficult to say. He also contended that while tacit knowledge can exist on its own, explicit knowledge can only be tacitly understood. He concludes therefore that all knowledge is either tacit or tacitly rooted and that consequently wholly explicit knowledge is not possible. This contrasts with Nonaka and Takeuchi (1995) who propose that tacit knowledge can indeed be converted into explicit knowledge by a process of externalisation.

The concept remains a source of energetic debate and further examples of how variously it is seen include: residing with the individual (Johannessen *et al, 2001*) or within collectivities (Collins, 2001; Nelson and Winter, 1982); experiential (Wagner *et al*, 1999) or innate (Torff, 1999); while Argyris (1999) notes that it can be the source of both rapid action in novel situations and defensive routines. There also remains much discussion as to whether taciticy is ineffable and inarticulable (see for example, Ambrosini and Bowman, 2001; Tsoukas, 2003) or merely difficult but not impossible to articulate (see for example, Nonaka and Takeuchi, 1995; Boiral, 2002). Indeed, Morosini (2000) suggests that these are in themselves false distinctions. He says that all knowledge must be tacit by its very nature since, once outside a person's mind (rendered explicit) knowledge becomes information for another person, it is only in the mind of the individual that it can be called knowledge.

Such ambiguities in the literature suggest that a single theory of tacit knowledge is still not well formed and *inter alia* issues of characteristics, location, transferability and utility remain problematic and offer possible locations for contribution.

What seems clear from the evidence in this study, as illustrated in the narrative and data extracts, is that clinicians use unique combinations of both explicit (procedural) and tacit (experiential) knowledge in their interventions. However, following Polanyi (1966), they can experience difficulty in making explicit precisely what they do, except in general terms. A useful explanation of this can be found in the work of Dreyfus and Dreyfus (1984) on calculative and deliberative rationality. Working in the field of artificial intelligence (AI) they proposed that it was the tacit, experiential dimension of knowledge that made AI unrealisable since they further held that no computer could truly experience and interpret its environment. In that specific context their position has been seriously brought in to question (see Casti, 2000) and is not pursued further here however, their original concepts continue to influence the development of theories of human activity.

For Dreyfus and Dreyfus (1984) calculative rationality implies application of rules and incremental refinement thereof, while deliberative rationality implies action guided by detached and reflective observation of events and one's intuitions. They draw on Feigenbaum and McCorduck (1983) who earlier suggested that, following Polanyi (1966), expert knowledge is ill defined because the expert cannot always explicate what s/he knows about her/his domain. Dreyfus and Dreyfus (1984) suggest that the process of skill development, and the concomitant knowledge base moves from novice through three intermediate stages (advanced beginner, competent, proficient) to expert. However, they suggest that, contrary to received wisdom about this process as moving from specific cases to learning ever more abstracted rules, our expertise is found on initially following rules and progressively becoming able to deal with a mass of specific cases through the application of broad heuristics. This is because with experience we intuitively see what is required without recourse to rules. Any similarity between what the rules say and what we do is then based on how well the course of actions fits the need rather than its existence as a rule or procedure per se. Also, Dreyfus and Dreyfus (1984) noted that rules do not contain the rules for their application, thus rules on their own may be less than helpful.

There is a clear parallel between the explicit dimension of explicit knowledge and calculative rationality since calculative rationality is grounded in the codified rules and procedures produced from explicit knowledge or, as Morosini (2000) would prefer, information. Similarly, the tacit dimension of knowledge can be seen to inform the concept of deliberative rationality. However, the key insight in the Dreyfus and Dreyfus (1984) argument is that when we ask an expert to describe the rules they follow we are forcing them to regress to the level of novice and remember rules they no longer use. This stands in contradistinction to the assumption in much of the tacit/explicit argument, and particularly to Nonaka and Takeuchi's (1995) notion of externalisation, that the experts are being asked to articulate rules that they use but no longer remember.

I believe that the calculative/deliberative model of Dreyfus and Dreyfus (1984) provides a very useful perspective on the interventions described by the clinicians in this domain. Accordingly the utility of a single, fundamental ideal archetype as a rationally descriptive concept grounded in calculative rationality, rather than either a definitive prescription or an averaged summary of previous interventions, again seemed most appropriate. Taking this view also acknowledged the practical infinitude of intervention options, which the data supported and which could not be encapsulated either in meaningful archetypal form much less by reference to rules and procedures. Rather, following Polanyi (1966) and Dreyfus and Dreyfus (1984) they were grounded in the clinician's tacit knowledge of their field and their use of deliberative rationality.

Following the same Aristotelian logic previously mentioned, the totality of interventions can therefore be effectively modelled using two constructs: prescribed (A) and not-prescribed (not-A) as shown in Figure 4.2.

Element	Abr	Type	Definition
Intervention	I		An intentional response to a presentation
	Ip	Prescribed	Interventions made in accordance with rules and procedures
	In	Not-prescribed	Interventions produced within a general framework of rules and procedures but sensitive to need

Figure 4.2   Typology of interventions

Taken together with the typology in Figure 4.1 this represents a simple arrangement of stimulus and response as shown in Figure 4.3a, which suggests that, *ceteris paribus*, specified presentations (Ps) will lead to prescribed interventions (Ip) and that not-specified presentations (Pn) will lead to not-prescribed interventions (In). While the first option could be explained in purely behaviourist terms (Skinner, 1976), effectively reducing response to conditioning, the second clearly cannot. It is intuitively persuasive and evident from the data that decisions as to the type of presentation and the form and content of the intervention remain with the clinicians, codified procedures notwithstanding. For completeness the model therefore needs a mechanism that intervenes between the simple stimulus of the presentation and the actions embodied in the intervention or response that the clinicians make. This revised arrangement is shown in Figure 4.3b

STIMULUS ⟶ RESPONSE

Presentation (**P**)   Intervention (**I**)

Specified (**Ps**)   Prescribed (**Ip**)

Not-specified (**Pn**)   Not-prescribed (**In**)
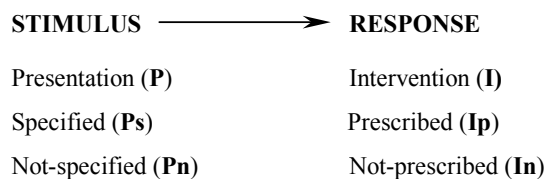
Figure 4.3a   Initial model of presentations and interventions

STIMULUS ⟶ [Intervening mechanism] **⟶ RESPONSE**

Presentation (**P**)   Intervention (**I**)

Intervening mechanism

Specified (**Ps**)   Prescribed (**Ip**)

Not-specified (**Pn**)   Not-prescribed (**In**)
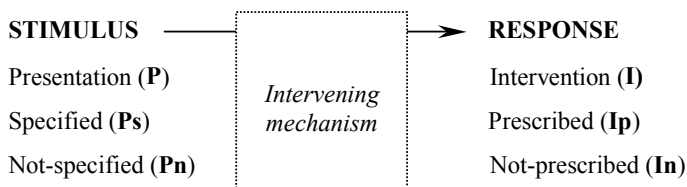
Figure 4.3b   Revised model of presentations, interventions and intervening mechanism

4.4.3   Attributes of intervening mechanism

The data indicate that an intervening mechanism is used to interpret the characteristics of the presentation and to decide on the content of the intervention. Eleven candidate attributes for this intervening process emerged from the coding process as elaborated in the domain analysis. These were: knowledge, skills, routines, rules, procedures, resources, representing the situation, generating resolutions, prioritizing actions, using resources, coordinating actions. These are shown in full in Figure 4.4.

Attribute	Abr	Definition	Descriptor
Knowledge	A1	The total knowledge set of the team	Knowledge available to deal with specified presentations
			Knowledge available to deal with unspecified presentations
Skills	A2	The total skill set of the team	Skills available to deal with specified presentations
			Skills available to deal with unspecified presentations
Routines	A3	The accepted ways of working	Predefined ways of working
			Emergent ways of working
Rules	A4	The set of organizational and occupational statements about what activity is and is not acceptable within the domain	Mandatory rules that prescribe interventions
			Guiding principles that allow for non-prescribed intervention
Procedures	A5	The details of how work activity is organized	Prescribed interventions to be followed inflexibly
			Contributory practice that supports non-prescribed interventions
Resources	A6	The material resources available to the team	Externally provided special to task
			Internally created or configured
Representing the situation	A7	The process by which the team reaches a common understanding of their situation	Routine, habituated interpretation of presentational cues
			Contingent search for unique presentational cues
Generating resolutions	A8	The process by which the team identifies practical resolutions	By selection between prescribed options
			By attending to unique aspects of presentation
Prioritizing remedial actions	A9	The process by which the team selects the order in which actions will be taken	Actions taken by rote
			Actions taken in order of perceived immediacy of need
Using resources	A10	The ways in which available resources are used	Resources are used in prescribed, conventional ways
			Resources are used in non-prescribed, unconventional ways
Coordinating team actions	A11	The process by which team actions are coordinated	The team responds to direct intra- or extra-team supervisory control
			The team mutually adjust roles and activity in response to need and to the contribution of others

Figure 4.4   Attributes of intervening mechanism

Having previously introduced the Aristotelian approach to categorization (A or not-A) I avoided the dilemma of polar dimensions for the attributes since I believe that the data revealed idealized types and a range of increasing divergence, common to stimulus and response as well as in the attributes of the mechanism. Although each attribute lends

itself to definition, I attempted to capture the range of meaning via what I have termed descriptors, rather than the polarizing connotations of dimensions. Also for convenience of future reference I have allocated abbreviations (A1 to A11) to the attributes.

4.4.4   Components of intervening mechanism

As the attributes of the process emerged, I combined *in vivo* and similar inferred terminology in the descriptors, rather than attempting to isolate crisper titles. As a consequence, it became evident by inspection that the attributes fell into two groups, each group having a different fundamental characteristic. These two groups of attributes appeared to constitute two discretely identifiable but closely related components of the intervening mechanism.

The first six attributes (knowledge, skills, routines, rules, procedures, material resources) correspond to the elementary cognitive, social and artefactual resources the teams may use to intervene in patient presentations. As the data extracts show, these were reported to emerge from planning and statistical expectation, professional education and training, and to include the rules and procedures that seek to guide how clinicians respond together with the core resources provided. Largely rationally designed, in anticipation of the assumed demands of the domain, they constitute the fundamental professional abilities of the team to face the challenges of the domain (Nordhaug, 1993; Weick, 1979), against which their professional competence is assessed.

Conversely, the second five attributes (representing the situation, generating resolutions, prioritizing actions, using resources, coordinating actions) appeared to be configurational in nature and expressed the way that the team generated particular interventions, those that were relevant to the unique characteristics of actual presentations, by configuring the cognitive, social and artefactual resources to hand, however complete or incomplete these might be. As the data show, they emerged more from experience in real and perhaps simulated circumstances than from more formal education and training.

Returning to the literature I discovered that Beier *et al* (2000) in a longitudinal study of what they have termed first responder readiness in medical teams referred to the fundamental professional competence to face the challenges of their domain as *preparedness*. As an extension to their concept of preparedness, they went on to differentiate the ability to configure resources in order to make an appropriate response to a specific event as *readiness*.

The concepts behind the theoretical descriptions used by this team, which they have continued to develop and to publish (see Richir *et al*, 2004; von Lubitz *et al*, 2003; von Lubitz *et al*, 2004) appeared to align quite well with the characteristics of the attributes that I had adduced thus far. However, although they provided an excellent provocation to thought, as expressed they did not quite capture the emerging characteristics. This may in part be because the thrust of the work that Beier, von Lubitz and others have undertaken is in *post hoc* measurement of performance rather than process and is intended to provide predictors of future performance and consequently more especially

of training needs. Thus preparedness describes the availability of human and material resources to manage particular event types and readiness describes the instantaneous ability to respond to a suddenly arising event. Overall they have little to say about the process of responding. However, although not the result of a grounded approach these two constructs of preparedness and readiness were analogous with the core categories of the coding process (Glaser, 1992; 1998)

Accordingly, I decided to modify these still very useful insights the better to reflect the patterns emerging from my own data. At this stage of the study, two core categories had emerged from the coding process that included the manner in which activity was resourced and the manner in which activity was configured. As a consequence I decided to designate the two components of the mechanism as a) *resourcing* to connote whatever preparation has been achieved in advance of events as elaborated in the attributes, and b) *configuring* to connote the process by which interventions are actually produced and they are thus shown in Figure 4.5.

Components and attributes of
intervening mechanism

Resourcing Component
Knowledge
Skills
Routines
Rules
Procedures
Material resources

Configuring Component
Representing the situation
Generating resolutions
Prioritizing actions
Using resources
Coordinating actions
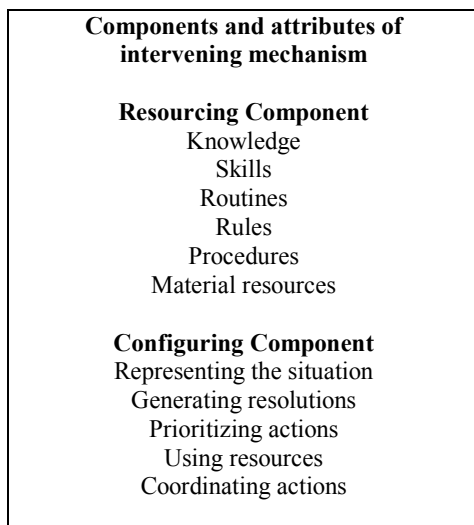
Figure 4.5   ***Components and attributes of intervening mechanism***

4.5   Summary of outcomes and implications for next domain of study

The data collected within a busy A&E department in a NHS hospital in the North Midlands of UK, using the grounded theory method reveal typologies relating to the types of presentations that clinicians encounter in the normal course of their work and the interventions they make. That this relationship extends well beyond the stimulus-response model of behaviourism (see Skinner, 1965; Watson, 1913) is clear from the data and suggests that a complex mechanism intervenes. The candidate components and attributes of this mechanism, shown in Figure 4.5, together with the presentation (Figure 4.1) and intervention (Figure 4.2) typologies previously adduced, map closely to a Stimulus-Organism-Response (S-O-R) model of symbolic interactionism (Blumer, 1969). However, the proposed attributes of the intervening mechanism extend well beyond the knowledge, skills and cognitive processes (suggested by Ilgen and Klein, 1988) that the clinicians employed and introduced non-cognitive candidates such as

rules, procedures, routines and material resources. Further, activity-based (representing, generating, etc.) attributes emerged. These attributes were grouped into resourcing and configuring components.

Thus the S-O-R model, while remaining conceptually sound as a generic framework for theory building, needed amending, the better to reflect the data. To take up these additional elements, I returned to the more fundamental idea of Blumer (1969) who suggested simply that a mechanism of interaction intervenes between stimulus and response. Although he went on to identify the elements of this mechanism in largely socio-cognitive terms, his initial general concept allows for considerable flexibility in what might constitute the mechanism in any particular case. Indeed, all models of behaviour seem to acknowledge an intervening mechanism. In behaviourism (Skinner, 1965; Watson, 1913) this mechanism can be seen as neuro-physiological, while in symbolic interactionism (Blumer, 1969) it is socio-cognitive.

Accordingly, I decided to use a Stimulus-Mechanism-Response (S-M-R) model that related the specified or not-specified characteristics of patient presentation (stimulus), to the prescribed or not-prescribed characteristics of clinical intervention (response), via a two-component mechanism of interaction (mechanism). Accordingly, for the next study the elements of the model became: stimulus, resourcing component, configuring component, and response, as shown at Figure 4.6.

Stimulus → Resourcing Component → Configuring Component → Response
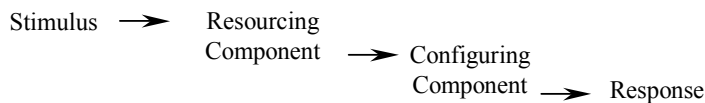
Figure 4.6   Expanded model

In addition, the model draws on notions of calculative and deliberative rationality (Dreyfus and Dreyfus, 1984) reflecting the manner in which clinicians combine the more calculative characteristics of professional education, guiding rules and procedures and material resources with the more deliberative characteristics of intuition born of practical experience to configure responses.

Having completed the analysis of the A&E domain, I next sought to discover whether the revealed characteristics of stimulus, response and mechanism were domain specific or remained stable between domains. Accordingly, the next stage of the study needed to look at a domain that shares the general contextual characteristics of unpredictability, high velocity, error sensitivity and high consequence but has theoretically significant differences. Because my focus is on team level behaviours, I selected as significant the characteristics of the meso-level environment of the team rather than either the macro-level of the organization or the micro-level of the individual. The following domain specific meso-level characteristics emerge from the data.

The normal work of the A&E department is unpredictable since they are unable to specify what presentations they will encounter either instantaneously or over a shift:

'…we don't know really from one minute to the next what the symptoms or urgency of the next patient will be or at what rate they are likely to arrive.' (CON)

The work is also continuous because A & E departments have a 24-hour remit:

'The unit is open for 24 hours per day and the staff is on either a two or three shift cycle' (WDM)

The focus of attention is proximal that is to say the clinicians are in direct physical contact physical with their patients and the influence of the team on outcomes is both direct and immediate:

'The fact that we are in close contact with our patients means that the results of what we do are immediate and obvious on an almost minute to minute basis.' (SpR2)

Since teams form round tasks, team constitution is dynamic within the more stable structure of the total shift:

'We tend to form teams around the presentation depending on what is needed - nurse, radiographer, anaesthetist, surgeon or whatever, and we pool our expertise' (SpR1)

The urgency implicit within their work tends to render them dependent on intra-team support:

'…we all know something of each others' jobs so we can use that when the unexpected arises rather than just insist on being a nurse or an anaesthetist or a surgeon or whatever.' (CON)

Since this is the only hospital-based activity where a complete spectrum of illness and injury is managed clinical qualifications are in general medicine:

'Essentially this is general medicine with a focus on the resuscitation, assessment and further treatment of acute illness and injury.' (CON)

These characteristics are summarized in Figure 4.7.

		Characteristics		
Predictable		Normal operations	X	Unpredictable
Continuous	X	Type of activity		Discontinuous
Proximal	X	Focus of activity		Remote
Direct	X	Influence on outcomes		Indirect
Static		Team composition	X	Dynamic
Intra-team	X	Support		Extra-team
General	X	Qualifications		Special

Figure 4.7   Key characteristics of the A&E domain

The notion of theoretical sampling (Glaser and Strauss, 1967) implies that informants and cases are selected on the basis of purposive rather than random sampling. As Partington (2002) explains, this allows the data collection strategy to be guided by emerging theoretical ideas and allows the researcher to retain control of the whole

theory development process. Thus, maximizing similarities between cases allows for confirmation of theoretical developments while maximizing differences allows for the emergence of new insights. I had pre-identified the domains in which I would undertake this study for their clear differences in task and environment (A&E, ATC and FCR), and in order to negotiate access. I was therefore predisposed towards a maximizing differences sampling strategy but it remained moot as to which of the two remaining domains would be most theoretically different from this first domain of A&E when judged against the characteristics in Figure 4.7.

Since this was a decision I needed to make in advance of data collection, my own knowledge of the Air Traffic Control (ATC) domain, based on extensive experience as a military pilot, informed the view that the meso-level characteristics in this domain were sufficiently different from A&E to offer a good theoretical contrast - a view subsequently supported by the data. Using this personal professional knowledge I reasoned as follows.

Normal operations are predicted and the basis of operations is the daily traffic flow plan of forecast departures, arrivals and transits.

Activity is continuous, as in A&E, but the focus of activity is remote, with some aircraft being several hundred miles away from the controller.

The ability of controllers to influence traffic flow, procedures notwithstanding, is indirect because it depends on the co-operation of remote team members that include pilots and controllers in other sectors and regions.

The base team composition is static within the shift but the influences of the preceding characteristic mean that there is a dynamic element.

As a natural extension of the preceding two characteristics the majority of support is therefore extra-team

A controller's qualifications are special to his environment, although they will benefit from qualifications carried over from other task environments as well as generalized experience.

These characteristics are summarized and compared with A&E in Figure 4.8.

	A&E	ATC	Characteristics	ATC	A&E	
Predictable		X	Normal operations		X	Unpredictable
Continuous	X	X	Type of activity			Discontinuous
Proximal	X		Focus of activity	X		Remote
Direct	X		Influence on outcomes	X		Indirect
Static			Team composition	X	X	Dynamic
Intra-team	X		Support	X		Extra-team
General	X		Qualifications	X		Special

Figure 4.8   Comparison of key characteristics of the A&E and ATC domains

In consequence, I chose as my next domain of study a major air traffic control centre in UK.

CHAPTER 5

RESULTS FROM AN AIR TRAFFIC CONTROL CENTRE

5.1   Introduction

I now present the results from the second domain of study – an Air Traffic Control Centre (ATCC). Following a similar format to that of the previous chapter, I begin in this section with an overview of National Air Traffic Services (NATS), the organization responsible for the provision of a range of enroute and airport services throughout the UK. Next I give a more detailed description of the role and activities of London Terminal Control Centre (LTCC), the ATCC at which I undertook the study. I include some observations on data collection and analysis methods in the light of the outcomes of the first study. In Section 5.2 I present the results of the domain study, linking examples of the data I gathered by way of an integrating narrative. I then progress in Section 5.3 to analyze the data and to identify how I have used the outcomes to refine initial concepts adduced in Chapter 4. I conclude this chapter in Section 5.4 with a review of the outcomes and the implications for the third study.

5.1.1   The Organization of Air Traffic Control in UK

National Air Traffic Services (NATS) provides air traffic control services to all aircraft flying in UK airspace, as well as those flying over the eastern part of the North Atlantic. It is a public private partnership between the Airline Group, which holds 42%, NATS staff who hold 5%, UK airport operator BAA plc, with 4%, and the government, which holds 49% and a golden share. The Airline Group is a consortium of seven UK airlines: British Airways, bmi British Midland, Virgin Atlantic, Britannia, Monarch, easyJet and Airtours.

The main function of NATS is to provide en route air traffic control or air traffic management services. In addition to this enroute service, NATS also provides air traffic control services at 14 of the nation's major airports including Heathrow, Gatwick, Stansted, Birmingham, Manchester and Glasgow. To achieve all this it operates and maintains a nationwide communications, surveillance and navigation network as well as providing engineering support at all operational units. It also carries out advanced research and development, including software for current and new systems, and trains air traffic controllers at the school located at Bournemouth Airport and engineers at Heckfield in Hampshire.

The air traffic management service is delivered by highly trained and qualified controllers supported by sophisticated technical systems. Controllers have a four-year training programme from initial entry to becoming fully operational and are formally licensed, after which they are subject to continuous assessment of individual operational competence as well as formal annual reviews and re-validation of licence.

NATS is subject to tough safety regulation as a corporate body, from the Civil Aviation Authority (CAA) indeed, the CAA model of independent safety regulation is increasingly being adopted worldwide in the air traffic management industry.

The enroute service is provided from four centres that are continuously operational 24 hours per day, 365 days a year. Arranged north to south geographically these are:

Oceanic Area Control Centre, Prestwick, Ayrshire

The Oceanic Area Control Centre (OACC) provides air traffic management to aircraft flying over the eastern part of the North Atlantic from the south of Iceland to north of the Azores. As radar only has a range of some 200 miles, controllers in the Oceanic Area Control Centre use position reports and estimates passed from pilots to ensure aircraft are safely separated. This information is provided using high frequency radio and is transmitted and received via a radio communications station at Ballygireen, near Shannon in Ireland.

Scottish Area Control Centre, Prestwick, Ayrshire

The Scottish Area Control Centre (SACC) handles aircraft flying in the Scottish Flight Information Region (FIR), an area that stretches from north of a line from Carlisle to Newcastle to near the Faeroe Islands, including Northern Ireland and the surrounding seas. Military controllers provide services to civil and military aircraft operating outside controlled airspace in the Scottish FIR. The military controllers work closely with civilian controllers to ensure safe co-ordination of traffic.

Manchester Area Control Centre located at Manchester Airport

Manchester Airport is unique in the UK. As well as handling flights using the airport itself, it is also the site of the Manchester Area Control Centre (MACC) supervising regional air traffic in the Manchester area.

London Area Control Centre, Swanwick, Hampshire

The London Area Control Centre (LACC), near Fareham in Hampshire is one of the largest and most advanced air traffic control centres in the world. It entered operational service in January 2002 and handles aircraft flying over the whole of England and Wales, a task previously undertaken from West Drayton (see below), with the exception of the Manchester area below 21,000 feet and the London and south-east area below 24,000 feet. On a normal day, the area control centre handles up to 6,000 flights. Radar information is fed into the Swanwick system from nine sites in the UK.

London Terminal Control Centre

The London Terminal Control Centre (LTCC) handles transit traffic below 24,500 feet together with arrivals and departures from London's airports in what is known as the London Terminal Control Area (LTCA). This Centre is the focus of study in this domain and is therefore described in detail in Section 5.1.1

5.1.2 London Terminal Control Centre

The London Terminal Control Centre (LTCC) is located at West Drayton near London and is divided into two operational functions, one generally for civilian traffic, and the other for the co-ordination of military traffic.   Controllers in the terminal control room handle traffic below 24,500 feet flying in transit across, arriving at or departing from the airports within, what is known as the London Terminal Control Area (LTCA). This area, which is one of the busiest in Europe, extends south and east towards the coast, west towards Bristol and north to near Birmingham

Controllers provide the approach service to aircraft using the major international and municipal airports at Heathrow, Gatwick, Stansted, Luton, London City, Northolt and Biggin Hill ensuring aircraft descend in a safe and orderly stream ready to land. At busy times, aircraft might be directed to holding patterns, usually associated with radio navigation beacons, where they descend, under the controller's guidance, before being sequenced and released for their final approach, and finally handed over to their arrival airport. The reverse process affects aircraft departing the airports. These are handed over to LTCC shortly after take-off. The controllers then guide the aircraft into the airways system where they are eventually passed on to staff in the area control operations room at Swanwick (q.v.), or provide an off-airways transit service.

The control room has 32 controller positions arranged down two sides of the room. The supervisor and support suites are arranged down the centre of the room. Each position has a 20" full colour monitor that provides a high quality radar picture. The displays are set-up and controlled using computer-style, on-screen menus, controlled by tracker ball. These are fed with radar information from 12 radar sites, from Heathrow airport to Great Dun Fell in the Pennines augmented by 21 transmitter/receiver sites for radio communication using 140 frequencies. Separate displays provide links to external data systems that provide information on weather conditions, arrival orders of inbound flights and pending departures. All radar and radio information is continuously recorded and archived for incident analysis.

Military controllers provide services to civil and military aircraft operating outside controlled airspace. The military controllers work closely with civilian controllers to ensure safe co-ordination of traffic flying in uncontrolled airspace above 24,500 feet or crossing national airways. The military controllers also provide emergency services to aircraft in distress or requiring diversion to another airfield. As the threat from terrorist action in the air has become more transparent, there are also contingency plans for scrambling fighter aircraft to intercept and escort suspicious aircraft.

LTCC engineers are responsible for maintaining the integrated systems that support the civilian and military control positions to ensure continuous operation. The engineers are also responsible for the National Airspace System computer that holds the database of all scheduled flights and provides flight progress strips for the controllers.

5.2 Data collection and analysis.

To recap my argument in Section 4.4 of the previous chapter, the choice of the Centre as second study was based on the feature of grounded theory known as theoretical

sampling, seeking to maximize and minimize selected differences and similarities that exist between cases. Here, similarities are maximized within the unpredictable, high velocity and error sensitive context dealing with potentially life threatening events. Data therefore has the potential to relate to similar phenomena and to refine previous categories of data. Conversely, differences are maximized within the meso-level characteristics of the domain. This provides the opportunity for new categories to emerge based on the contrast between cases. Both outcomes are of equal value to the developing theory.

I was fortunate to gain access to LTCC through personal contacts established during my career as a military pilot. Among these were the Director of the Safety Regulation Group at the CAA and a former Director of Air Space Policy, both of whom are old school friends and fellow former RAF Officers. The significance of the Centre to the research was the acknowledged high density of traffic in a relatively small piece of airspace coupled with the co-location of the distress and diversion cell. These two facilities offered excellent opportunities to collect data in a high velocity and error sensitive environment.

I undertook orientation observation and interviews in the Centre between 7 July and 1 August 2003. I was given clearance to investigate any of the activity in the operations room. However, reasoning that the intensity of operation was evenly spread across sectors, and therefore control positions, I decided to stay with a single control position for orientation before beginning the interviews. Using several different opportunities I was able to observe activity throughout the 24 hours of operations. My research was well supported by having access to the informants shown in Figure 5.1 below.

Informant	Code	Role
Supervisors x 3	SUP1	Senior controllers who manage the work of tactical
	SUP2	controllers and air traffic assistants
	SUP3	
Tactical Controllers x 5	TAC1	Controllers who maintain the safe and orderly movement
	TAC2	of aircraft along major air routes and around airports by
	TAC3	giving instructions to and receiving reports from pilots
	TAC4	
	TAC5	
Air Traffic Assistants x 2	ATA1	Assistants who give general support to tactical controllers
	ATA2	and supervisors
Distress/Diversion Controller	DDC	Military Controller who deals only with emergencies

Table 5.1   Key informants

Using the observation largely as orientation I was also able to elicit explanations of activity while observing. I felt that this process of clarification was particularly important in this domain so that any assumptions based on my previous professional experience did not compromise the data that would be generated during the interviews.

I conducted all 11 interviews, averaging 70 minutes duration, off-shift so that the immediate and unpredictable nature of live events did not intervene in the interviews nor did my presence interrupt the controllers' tasks. The interviews followed the same loose structure as in the previous domain, to identify those phenomena that the

informants considered important in their work, exploring the same three main issues, namely: the types of events to which they respond during their work, the types of responses they make, and the mechanism that produces the intervention.

5.3   Domain narrative

This narrative for the ATCC domain of study, tracks a relatively large number of short duration events rather than relating a single story over time. However, even these essentially and necessarily fragmented events build to provide an overview of the style and trajectory of activity within LTCC

As explained earlier, the purpose of the LTCC is to provide en route air traffic management services to aircraft flying below 24,500 feet in transit across, arriving at or departing from the airports within, what is known as the London Terminal Control Area (LTCA).   An immediate impression is that the control room is very busy but strangely hushed. The atmosphere of calm, while real, camouflages very intense levels of activity. As one Supervisor explained, the service the controllers provide is first and foremost found on control of the scheduled and charter traffic of the passenger and cargo airlines together with the flight planned movements of military and private operators and includes special flights by, for example, heads of state.

> 'Each day we have a rolling plan that collates schedules and volumes of traffic across the whole of UK airspace. It is based on what we know from notification, what we expect from experience, for example during the summer we get lots more private flyers and display traffic popping up and is moderated by the weather. This is integrated with similar plans in contiguous airspace.   So for example, to take account of time zone differences and airport noise restrictions, most North Atlantic flights operate in two time blocks - westbound in the late morning and afternoon and east bound during the night and early morning. That sort of thing gives us the structure for the day if you like, what we expect to happen. That means scheduled departures and arrivals, and anything else that is notified. That also includes Royal or Presidential flights, when we have to apply different rules for separations. We know that things will happen to intervene and they do, but we plan what we can so that we can at least match our resources and our people to that as a starting point.' (SUP1)

During a general discussion with two supervisors around the normal and off-normal events that constitute the working day in the centre one supervisor was keen to make a distinction between the dynamics of the task and emergencies. This awareness of the continuous occupational need for speed and precision being qualitatively different from dealing with emergencies emerges continually throughout the study of this domain.

> 'When I was in training as a controller it took me a while to latch on to the different situations we face. Eventually, I decided that our work has four influences but they are all what you call UHiVES. First, there is the normal planned flow of traffic. Then there are what we tend to call disturbances, anything that interrupts the steady flow and increases the work-load, from weather to additional traffic. Then there are emergencies, that is when aircraft are in trouble. Remember that is not an emergency for us, that is what we are here for, to help them.   But even they can merge into one another, so we learn to deal with what we have got rather than some pre-defined version of it. Last there are emergencies here in the Centre' (SUP2)

73

His colleague cited a specific example of an emergency in the Centre.

> 'The whole system at West Drayton crashed last week around six in the morning on Tuesday and it was a struggle to get the system back up. Everybody thought it was teething troubles at Swanwick but it was with our data processing system here at West Drayton, because an engineer decided to test an old computer system that serves all airports in London and the south east. So as if the job isn't stressed enough we sometimes throw in our own problems. But that has massive implications for the safe flow of traffic as you can imagine' (SUP3)

This final comment highlights the overriding purpose of all air traffic management systems, the safe and expeditious, sometimes referred to as efficient, flow of air traffic as one of the controllers emphasized.

> 'Put briefly, the safe bit refers to avoidance of incidents and the expeditious or efficient bit refers to avoidance of delays and the economic costs for operators that such entail. I suppose in one sense that these are conflicting requirements, but that is why we put safety first so no-one is in any doubt about where their duty and expertise are directed. (TAC5)

So, although much of the work load can be planned, based on published schedules and otherwise notified traffic, which have been agreed with the airlines, the British Airports Authority (BAA), military users etc., there are numerous disturbances; additional responsibilities that arise from unplanned but unproblematic requests for flight variations.

> 'When you give instructions to a pilot he is at liberty to ask for variations to meet requirements of which we are not aware, a fuel consideration, a performance limitation, avoiding turbulence, crew or passenger incapacity. Where possible of course you accede to the request, and the more serious the event the more likely and the more immediately you are to accede. But that probably has knock on effects in traffic flow so it is manageable but you can't treat it in isolation. It changes the whole picture'. (TAC2)

But the controllers must also deal with non-scheduled traffic.

> 'Most of the traffic in our area is on the airways system, that means they are following established routes, between major or regional airports. But we also have to give a service to others flying from smaller and private airports. A private jet getting airborne from North Weald, right next to the M11/M25 junction, en route to Bournemouth on the south coast will not follow standard routing and will therefore cause a disturbance to the normal planned flow. It's easy to deal with if the weather is OK and everything else is going to plan, but it's another disturbance. And that is before you consider the basic incompetents, the private pilots who think they can fly anywhere and just bumble into the airspace.' (TAC4)

A similar challenge arises when the weather affecting the area is of an unpredictable type, perhaps most often thunderstorms, which form and dissipate quite quickly but when and where each will build is not predictable. While a storm is in progress it can cause extensive disruption because of the severity of the weather, turbulence, hail, lightning that might occur.

'If a severe thunderstorm tracks across your area you are affected by the track and intensity of the storm, the weather it produces, snow, hail, rain, and the density and type of traffic. Severe weather reduces the number of aircraft you can handle simultaneously, especially on climb out or initial recovery because each one requires more thought. So while the situation may still be manageable it is always very dynamic and certainly not the sort of thing you can define in detail in advance, beyond being aware of the weather both as forecast and as actually happening.' (TAC1)

Further along the continuum of disturbance, more extreme events supervene, that also require immediate and urgent attention. These can variously range from the direct effects of a local event to the consequences of a much more remote event. Examples of this are the Kegworth air crash in January 1989 and the terrorist attacks in New York in September 2001.

'Some years ago I was controlling when that 737 crashed at Kegworth. The flight crew going from London to Glasgow had experienced an engine malfunction but misidentified which was the faulty engine and eventually shut the wrong one down and asked for an emergency landing at East Midlands airport. We gave them a direct track and they started descending. That affected other aircraft enjoying trouble free transits. Then the 737 crashed less than a mile from the runway right across the M1 motorway, carnage. Dealing with that was the airport's problem but of course it closed East Midlands. Our problem was that we still had aircraft inbound to land at East Midlands at a very busy time of day, so diversion airfields were also busy.' (SUP1)

'The immediate response to the 9/11 attacks was that the US rapidly closed its airspace. That meant that they also turned back North Atlantic traffic. Our problem was that we had aircraft being turned back from US airspace at various stages of their transatlantic flight, aircraft already airborne heading out towards the Atlantic and aircraft on the ground waiting for departure. They all needed handling and diverting into airfields that were already full. Now, whatever anybody says about expecting the unexpected, that was unexpected.' (TAC 3)

The examples cited above serve to illustrate that there is a range of events to which controllers respond. They begin with a plan, but the plan is invariably, almost immediately and then continually disturbed. Also, what starts as a relatively minor disturbance can escalate into a major incident, possibly with catastrophic results. Some events are immediately penetrable, while others are more challenging to interpret. The range of disturbance also appears to be continuous rather than readily compartmentable.

This range of events is mirrored by the range of actions that controllers take to manage the airspace both safely and efficiently. The basis of all activity is the compendious range of procedures.

'The whole of air traffic management is layered, with policy and practice coming from international, national and local origins, each augmenting the other They are internationally agreed so that, in normal operations, everybody knows what to expect. People don't like unnecessary surprises. When a Chinese pilot enters UK airspace he should know what to expect. So the way we deal with the thousand and one things that happen in a day are certainly based on our procedures. Insofar as the plan works then we can use published procedures to maintain separations. Imagine that every aircraft is

flying in a moving parcel of airspace that is three miles in diameter and one thousand feet thick and those discs are intended never to touch.' (TAC5)

Many of the disturbances that do occur can be managed successfully and with little disruption by minor and transient modification to a procedure.

'Varying the published pattern or routing so that an aircraft avoids an area of poor radar performance or weather clutter or congested airspace means that we have positive control throughout, and means safety, perhaps for a few more gallons of fuel. We just do that as local practice, because until you sit here in front of the radar day after day these effects are not obvious. The way the airspace is divided and the way the technology works will always throw up little wrinkles that no-one thought of at the design stage so, unless it is a major problem you just change it as the situation demands. Going back to the safety thing, a safe transit, take off or landing is always more important than the assumed efficiency of any specific procedure.' (TAC2)

For more demanding events, when procedures cannot be simply amended, it might yet be possible to produce a safe and efficient resolution. One example, the UK response to the 9/11 incident in New York, involved selective application of a range of procedures, but in a way not enshrined in any formal description, combined with invention of wholly new work-arounds.

'Take the 9/11 episode as an example. The US rapidly closed its airspace but they also turned-back Atlantic traffic. So we had a similar problem recovering aircraft from the Atlantic routes, holding our US departures on the ground, finding airfields with the capacity to take the overflow, incorporating new airspace restrictions and increased air defence traffic. Now it is not rocket science to decide first hold all Atlantic departures, that reduces the total number of aircraft airborne, next find airfields with space to accommodate diversions, then start to sequence the inbound aircraft taking account of rapidly increasing restrictions like no direct over flights of Whitehall and be prepared to integrate air defence fighters. Much of that has procedures or at least guidance. But the details can become messy. The number of aircraft involved, any with fuel shortages, deteriorating weather. Overall, what we achieved was a procedure-based response that had no precedent in procedure or experience. We didn't have a book labelled 9/11 on the shelf, or anything like it. (TAC3)

As a further example of how the inadequacies of rapid response processes are highlighted by their immediate and unavoidable consequences, the 9/11 incident led to a major and strategic reappraisal of the adequacy of plans and procedures in anticipation of future events, the incident having been of such unique characteristics as to have been wholly outside extant normal and emergency procedures.

'As a result we now have fairly comprehensive procedures to deal with the same kind of thing and of course new procedures to deal with similar events in our own airspace including liaison with the military for air defence support. But you can bet your life that the next one will be different so the new procedures will only give us a framework.' (SUP3)

Although radical, this represents only a more extreme example of the ways in which improvements are made on a more continuous basis from the direct experience of the controllers.

'When I was talking about local variations earlier, if it is important enough, we may be making a case for changing the published pattern. A formal change, of course, affects other users and may lead to a fundamental reorganization of part of the airspace. It's stones in pools really, how far are the ripples felt? But our initial concern is certainly resolving the local and immediate issue. It is pressure situations that tend to make the problems obvious. In this business we are always looking for ways to reduce the unnecessary workload. But we know pretty quickly if what we do is effective. It is then for us to decide in slower time whether to change formally or to remain flexible' (TAC3)

Again, as in the A&E domain, these are consequences of the characteristics of the domain rather than examples of immediate response and fall outside the focus of the research. However they represent an interesting insight to which I return in Chapter 7.

For some emergencies, the ability to improvize becomes more important even if that means working outside normal controlling responsibilities. The advantage the controllers have, perhaps especially the distress and diversion controllers, is that in any air traffic related incident they probably have the most integrated picture of what is happening as well as excellent relationships with other emergency and support services. This tends to make requests for assistance immediately credible.

'The ability to improvise under pressure is vital. I was on duty a few weeks ago when I was called by a pilot bringing a young girl from the south coast to a hospital in London for emergency treatment. The pilot was concerned that he might have trouble finding the hospital at night and in poor visibility and so he called D&D. I asked the police to have a car waiting on the outskirts of London with its blue flashers going to lead the low flying helicopter straight to the hospital. We also agreed that they would halt traffic outside the hospital with two more police cars to make its location more obvious. Its great when something like that works but you won't find it in the international regulations.' (DDC)

However, on some occasions it is not possible for the controllers to do any more than alert emergency services.

'Others we can do little for them, like ejections from military aircraft. Often the only notice we get is when we hear a pilot saying 'ejecting'. We auto triangulate the transmission so we know where he is pretty accurately. Then normally all we can do is alert the local emergency services and hope that the aircraft doesn't crash into anything. But recently I was able to contact a helicopter on a routine flight near an ejection site, over the Wash. He went to the site and waited till the search and rescue boys arrived' (DDC)

One important theme that emerges from the foregoing is that the teams in which controllers work extend beyond the immediate group within the control room and can include a variety of others even on the most transitory of bases. Ironically, the most transitory is probably that with the pilots for whom the service is being delivered.

'When a pilot checks in I don't now him or anything about him, but unless he is willing to accept my instructions or can give me helpful information as to why and how he wants to vary them we cannot get very far. The safe and expeditious flow of air traffic is at the very least a shared responsibility between pilot and controller. So I see the

team in which I work as depending on the situation. Sometimes it is just the controllers here, agreeing sequencing say, or includes controllers in other sectors agreeing hand-offs, or D&D with emergencies but always, always, always the pilots, or at least with the pilots in mind, the people I know least about.' (TAC4).

In spite of this transient team composition, the division of labour within the LTCC remains found on clearly defined knowledge and skill sets, as evidenced in the strict licensing arrangements. However on any shift the knowledge and skills of all the controllers, except those under local on-job training to validate a licence, are similar, with perhaps some non-critical variation in experience, and can be pooled. It is therefore possible and practical as well as frequently essential for controllers to work with considerable flexibility. A good description came from an air traffic assistant.

> The way we organize it is this. Traffic is controlled by a small team of controllers, comprising a single tactical controller dedicated to each airspace sector, overseen by a chief sector controller position which acts in a coordination role. By definition the controllers all have an Area rating and an Approach rating that means they can be allocated to a sector for enroute work or an airport for approach work. The supervisor also has a supervisors rating. Then there are assistants like me. We are not licensed to control aircraft but we help the controllers and the supervisors by preparing flight strips, by monitoring data displays, taking and making phone calls and doing the general administration. Lots of assistants go on to do the full controller training as I intend to do, but I have enjoyed this a lot.' (ATA2)

Equally, the career progression of the controllers builds on previous experiences and qualifications such that an area controller at LTCC will have a background in all the other specialisms and therefore broad experience in and understanding of the effects of his decisions.

> 'The hierarchy of licences ground, tower, approach, area means that you are always extending your knowledge and more able to deal with the unexpected because you have a broader perspective.' (SUP2)

Fundamental to all air traffic management is the international context. While tolerant of national and even more parochial needs, the essentially global dimension of flight has produced volumes of internationally agreed rules and procedures that enjoy universal acceptance.

> 'Our rules are a combination of internationally and nationally imposed. Literally hundreds of them and you break them at your professional peril but the majority of them are safety related so it behoves you to know them. I like to think that rules are to be obeyed otherwise why have them. Nonetheless, rules like maintaining minimum separation distances between aircraft may in extremis have to be bent for overriding safety reasons. If you can justify it then it will be accepted. But better to have the rule and occasionally bend it than not have it I think. It helps to frame what you do rather than just be a dictate. The rule gives you a starting point so that whatever you do, you know by how much you are moving away from it. (TAC1)

Not surprisingly then these procedures form the basis for all responses.

'Our procedures are designed and published internationally and so to tell a pilot to execute a Biggin Hill arrival for landing Heathrow 27 Right means something very specific to us both. We can vary a procedure, approach, departure or enroute to take account of weather, traffic density, emergencies etc but you must declare that you are varying it and you reintroduce the procedure as soon as possible. (TAC2)

Modern air traffic management is also a resource intensive environment. This includes the radar systems in use and the integrating systems that can provide a clear digitized representation of information gathered from a range of sources

'You have seen the kit, state of the art radar, full colour monitors, ancillary data handling displays, nearly a hundred and fifty radio channels, real-time weather displays, communications and data handling, duplex and triplex systems. We need that to cope with current traffic density and diversity. But the demand is still in danger of leading the capacity. (SUP3)

But with safety the prime responsibility, the vagaries of technology, even with redundancy built in, require more traditional buffers as well.

'Before we had all the technology we had to work with just paper slips, a basic analogue radar and a radio using very large separation criteria. If the radar or data goes down now we revert through standby or remote sites all the way back to paper and radio if necessary, but at the expense of increased separations and reduced traffic flow. You can't just switch off and tell every one to fend for themselves.' (SUP2)

In spite of the mass of associated technologies the human contribution remains pivotal to the domain.

'The technology is important, especially as traffic density increases, but it still has massive limitations that, at present, only we humble controllers can deal with. I believe that it is best seen as an advanced tool, it extends our capability but it can't replace us. It can provide us with all sorts of helpful information and even some options but it can't make better decisions, at least not yet. And that is because you can't programme every possible eventuality into the thing, because we can't predict them all' (TAC5)

The modern process of controlling aircraft is based on visual and aural cues, enabling controllers and pilots alike to build and maintain a comprehensive picture of the environment.

'Knowing what the plan is, knowing the weather, working the sector through the radar picture and the radios you get a real three dimensional feel for the airspace. That is important because of course the radar gives you a two dimensional view. You have to add the third dimension. So you are pretty much tuned in to what is happening and of course we talk incessantly. (TAC3)

This broadcast approach ensures that teams develop and continually refresh a shared representation of the situation. Sometimes this is based on formal control instructions.

'When Dave was handing over that Air France Airbus at 170 inbound Heathrow and requesting lower, I had the Emirates climbing inbound Dover. I tell Dave so we both know. We tell both aircraft on broadcast so that they and all the other traffic in those

sectors know. It helps us all have a three dimensional picture of the sky. That's especially important when things get busy.' (TAC5)

On other occasions it might be a simple prompt perhaps from an assistant, a reminder when the pressure is on and something might be missed.

> 'On one occasion, when we were sequencing landing traffic through Lambourne for Heathrow I noticed an aircraft coming of North Weald towards Lambourne that hadn't checked in and had no altitude read-out so we didn't know if it was a confliction. So I told Ken and he was able to keep his traffic clear until the pop-up checked in.' (ATA1)

This style of representation exemplifies the buddy system in use, involving mutual monitoring of suggestions, decisions and actions. When things are moving fast, whether the conditions are normal or not, teams maintain a shared picture of events, rapidly formed and continuously updated. Clearly evident is a default system in which agreement is assumed unless someone demurs.

Resolving situations that arise may be as simple as giving standard instructions to follow a published procedure, this can be essential in a hijacking. However, the use of procedures in one instance may require the modification of procedures elsewhere.

> 'Do you remember the Afghan hijack a couple of years ago? Well, getting that aircraft down at Stansted we used standard decisions and procedures for hijacking so that there were no surprises that might scare the hijackers confuse our controllers or compromise the security people. But that meant that the rest of the traffic had to be handled in an unplanned way both to keep it clear of the hijack and to cause as little disruption as possible.' (SUP2)

Indeed, most situations have more than one potential resolution and so discussion between controllers, and between controllers and pilots is frequently used rather than simple imposition.

> 'On one occasion, an aircraft requested clearance to a higher level that was already occupied. In discussion with a controller in the next sector infact sitting two positions away in the control room we agreed that a climb was safe if the aircraft accepted a reroute. The pilot agreed and so was allowed to climb after a short delay and when established on a new heading.' (TAC4)

Safety demands that aircraft flight paths are coordinated in particular ways and these actions have a natural priority. However, when disturbances, especially aircraft emergencies occur the priorities might need amending or additional actions interposed.

> 'At the airports you land aircraft before releasing take-offs, you try to land light aircraft before heavies because of turbulence. In the approach sector you recover lower altitude aircraft before higher altitude, but you may need to land lower fuel states before higher fuel states whatever the altitude. With emergencies, although the aircraft with the problem needs to land, if it may block the runway you may land other aircraft ahead of the emergency or divert it.' (TAC5)

The extensive material resources available to controllers are used essentially to allow actions to be more responsive and rapid, and separations to be reduced.

'Under normal conditions we use the technology to augment the procedures. It gives us a very good visual and data based picture of the sector and so we can relate aircraft position in three dimensions to each other, to relative positions in our flight procedures or in relation to controller instructions for non-standard tracks. Just as if we loose radio contact with an aircraft we can still monitor its flight on the radar and control others away from any potential conflictions until we regain contact. That's what it is designed for'. (TAC5)

But the technology is also used in unconventional ways as occurred during an incident in Wales.

'About three weeks ago a guy who it transpired was an aviation enthusiast was climbing in Wales. He saw what he thought was a glider crash, got to the site and broke in on an aviation band emergency frequency to report a microlight accident and I was able to direct rescue services to the area based on the position he reported which refined our triangulation. I am not convinced that he had a proper radio telephone licence to use the air emergency frequency but we didn't complain.' (DDC)

In spite of the autonomy of each controller, the importance of integrating the flow of air traffic, by coordinating activity in the approach phase to an airport with the sequencing of arrivals in the sector with the general flow of traffic within the terminal control area is continually reinforced. The process of coordination may be hierarchical with the supervisor directing operations, especially in difficult circumstances.

'I go back to 9/11 because it was so unique. As soon as it was obvious that some serious traffic flow problems were on the horizon we formed a plan of action among the supervisors that we continually updated and fed to the controllers. That put us in overall control of the situation but separated from the actual controlling of aircraft. That took the load off the controllers and left them to deal with the aircraft. (SUP3)

On other occasions, coordination leans more towards mutual adjustment of roles and inputs that pay little head to the hierarchy.

'When we got busy round 1700hrs today and my assistant had been called away the supervisor stood in as my assistant. I had control and he assisted me, I had the detailed picture for my sector and he didn't. So he didn't take charge and have me assist although he was the super. We do that quite a lot especially when it gets busy. Also, if I get an emergency especially a serious one or a hijack, another controller will take my other aircraft and leave me to deal with the emergency. We have to flex like that quite a lot. That's the advantage of our experience. (TAC4)

In this narrative I have reported the outcomes of data collection in the London Terminal Control Centre. As in the previous chapter the general description entails a necessary distillation of field data and is limited to luminous examples from which fundamental characteristics of the domain have been adduced in terms of the events that occur, the actions controllers take and the processes by which these actions are generated. These form the basis of the analysis that follows.

5.4   Domain analysis

The narrative in Section 5.3 provides evidence that expands on the constructs of presentation, intervention and mechanism formed in Chapter 4. Although as will be clear, there are many similarities between the two domains, it is the differences between them that lead to modification of the constructs to provide refinement for the developing theoretical model. For example, in Chapter 4 I used the *in vivo* titles presentation and intervention to remain closer to the data extracts. In this domain there are no uniform expressions for similar concepts. In order to subsume both approaches in a common terminology I have returned to the empirically derived and theoretically informed constructs of stimulus and response within the emerging model. Also, the data in Section 5.3 provide the opportunity to refine some attributes of the intervening mechanism.

5.4.1   The typology of stimuli

The data indicate that controllers respond to two identifiable stimuli: the events forecast in the scheduled flow of the air traffic management plan and events as they occur. As will be obvious from the data extracts, actual events invariably diverge to a greater or lesser extent from the forecast. Although in the data there are examples of varying divergence, these represent illustrative examples of a continuum rather than uniquely bounded instances.

Further, the events forecast in the rolling management plan do provide an estimate of activity that enjoys some precision largely on a statistical basis but only very occasionally as a matter of experience. By the end of a shift or a flying day, many elements of the plan in terms of total movements, traffic density, timings, arrivals, departures, procedures used etc will have been realized. However, none of the informants could remember an occasion on which disturbances had not intervened from the outset. Also the characteristics of these disturbances are an eclectic mix of almost infinite possibility. In consequence, while it is simple to identify the events forecast in the plan derived from experience and expectation, it is not possible either to predict or to make meaningful distinctions between divergences.

The data indicate that while the plan is a specifiable if idealized representation, events constitute an unspecifiable range of divergence. Accordingly, the stimuli in this domain fall into the same two types initially adduced in Chapter 4, but now renamed and shown in Figure 5.1.

Element	Code	Type	Description
Stimulus	**S**		An event that provokes an initial, or a change of, response from the team
	Ss	Specified	A stimulus that has been rationally conceived and described, informed by but not the average of previous experience
	Sn	Not-specified	A stimulus that has not been rationally conceived and described because of unpredicted characteristics

Figure 5.1   Typology of stimuli

As with the A&E domain, the reported opportunities to improve on safety and efficiency of flow are legion from coping with poor radar performance to identifying major deficiencies in provision; the 9/11 incident of common knowledge provides a compelling example of the latter. Again the immediate, obvious and unavoidable consequence of events in the domain was cited as a fundamental reason for improvement opportunities being readily revealed. The decision not to accord this a place in the basic typology is found on the fact that these opportunities are the consequence of outcomes rather than independent stimuli in the UHiVES context. As with the previous domain I comment on this phenomenon separately in Chapter 7.

5.4.2 The typology of responses

It is evident that controller's responses are guided by procedures, because these are internationally agreed, and published for the information of aviators. However it is also supported by the data that procedures, along with other forms of rule-bound or regulated activity are subject to increasing variation to match the exigency of events. Also evident is that while the potential for variation is unlimited, the culture within the domain limits variation to that warranted by the exigency and actively discourages variation by whim or caprice. This leads to the modified typology of response shown in Figure 5.2.

Element	Code	Type	Definition
Response	R		An intentional initial, or change of action
	Rp	Prescribed	A response made in accordance with rules and procedures
	Rn	Not-prescribed	A response configured within a general framework of guidance

Figure 5.2   Typology of responses

The logic of an intervening mechanism remains unchanged and so, together with the modifications cited above the model is amended to that shown Figure 5.3

STIMULUS (S)   **RESPONSE (R)**

Specified (**Ss**)   *Intervening   Prescribed (**Rp**)
                              mechanism*

Not-specified (**Sn**)   Not-prescribed (**Rn**)

Figure 5.3   Revised model of stimulus, response and intervening mechanism

5.4.3 Attributes of intervening mechanism

Analysis of the data revealed no new attributes of the intervening mechanism however; some valuable refinements to a number of the extant attributes emerged. First, the teams in this domain may be not only transient, depending on the event, but also spatially dispersed as for example between pilots in different aircraft and controllers at different geographical locations, while being involved in the same events. This

emphasizes the contribution of differentiated and distributed characteristics of the knowledge and skill sets. Second, the routines that are either culturally or situationally active while firmly team-based within a single location are shared by others who become transient members. Third, the rules and procedures of significance to the research are limited to those that are occupational, that is those that apply to the execution of operational roles. Renaming these attributes isolates them from organizational rules and procedures that apply to commercial or administrative matters. Fourth, given that knowledge, skills, routines, rules and procedures represent resources in the general sense, the significance of resources as an attribute is better expressed as artefacts to capture the intended material and generally technological nature. This refinement also affects the utilization attribute, which becomes use of artefacts. Throughout, the language is refined to align with the developing typologies of stimulus and response. These refinements do not indicate that any change is required to the component groupings, or titles, which remain as preparedness and readiness.

Continued use of the descriptors retained the richness they convey, and proved helpful when making the refinements suggested by the integration of data from this domain. It is therefore both practical and valuable to retain eleven descriptors rather than seeking differentiated, short-hand dimensional titles for each. Figure 5.4 illustrates the substantive refinements I made and includes the new abbreviations used for the attributes, shown as the initial letters of each.

Resourcing Component			
Attribute	**Code**	**Definition**	**Descriptor**
Distributed knowledge	**DK**	The total knowledge set of the dispersed team	Knowledge available to deal with specified stimuli
			Knowledge available to deal with non-specified stimuli
Distributed skills	**DS**	The total skill set of the dispersed team	Skills available to deal with specified stimuli
			Skills available to deal with non-specified stimuli
Team Routines	**TR**	The accepted ways of working within the dispersed team	Predefined ways of working
			Emergent ways of working
Occupational Rules	**OR**	The set of occupational statements about activity that is and is not acceptable	Mandatory rules that prescribe actions
			Advisory rules that allow for discretion in actions
Occupational Procedures	**OP**	The set of occupational statements about how rules are to be implemented	Prescribed actions to be followed inflexibly
			Guiding principles that allow for non-prescribed actions
Occupational Artefacts	**OA**	The material resources available to the team	Externally provided special to task
			Internally created or contingently configured

Configuring Component			
Attribute	**Code**	**Definition**	**Descriptor**
Representing the situation	**RS**	How the team reaches a common understanding of their situation	Routine, habituated interpretation of cues
			Search for significant contingent cues
Generating resolutions	**GR**	How the team identifies practical resolutions	By selection between prescribed options
			By attending to unique aspects of the stimulus
Prioritizing actions	**PA**	How the team selects the order in which actions will be taken	Predefined actions taken by rote
			Contingent actions taken in order of perceived immediacy of need
Using artefacts	**UA**	How material resources are used	Artefacts are used in prescribed and conventional ways
			Artefacts are used in non-prescribed and unconventional ways
Coordinating actions	**CA**	How team actions are coordinated	The team responds to direct intra- or extra-team supervisory control
			The team mutually adjust roles and activity in response to exigency and the contribution of others

Figure 5.4   Components and attributes of intervening mechanism

However, further analysis of the attributes and descriptors grouped in the resourcing component now suggested that they could be focused on two dissimilar purposes, the first to prepare for the predictable and the second to prepare for the increasingly unpredictable. For the first purpose, represented by the first descriptor in each case, the knowledge and skills are focused on specified stimuli, while routines, rules and procedures are predefined, and artefacts are special to task. Under these circumstances the resourcing component is designed, structured and resourced to cope with predicted and therefore specified stimuli. Under these descriptors, which relate to the ideal type notion explained earlier, I decided to refer to the component as in *specialized* mode, that is prepared to cope with specified stimuli. In this context the concept of explicit knowledge is again relevant. The ability to specify stimuli, *per impossibile*, is grounded in explicit knowledge and its ability to be exploited for utilization of organizational knowledge (Radcliffe-Martin *et al*, 2000)

Conversely, for the variety of alternate purposes, represented by the second descriptor in each case, the knowledge and skills are focused on non-specified stimuli, routines emerge, rules are more advisory, procedures are for guidance and artefacts are internally constituted. Here, the resourcing component is intended to cope with the vast range of increasing divergence from the ideal type. Under these descriptors I decided to refer to the component as in *generalized* mode, that is, prepared to cope with the manifold contingent aspects of non-specified stimuli. After further reflection I decided that, these specialized and generalized mode aggregations of descriptors, could now be credibly

applied to each of the individual attributes, embellished by the richer descriptor in each case.

Applying a similar logic to the attributes of the configuring component, the first descriptor for each attribute symbolizes processes that are habituated, performed by rote, making conventional use of artefacts, all coordinated by supervision, be that direct or procedure based. Under these descriptors the component can be termed to be in *passive* mode, that is configurations are standardized and require no original input. Conversely, the second descriptor for each attribute symbolizes responses that are increasingly contingent and therefore discovered, sensitive to need, make unconventional use of artefacts, all coordinated by mutual adjustment. Under these descriptors the component and therefore the individual attributes, can be termed to be in *active* mode, that is configuring is found on increasing levels of original input. Again, by keeping the individual descriptors rich, each attribute can now be parsimoniously referred to as in passive or active mode.

To cite two examples: First, team routines that are predefined are specialized and those that emerge, influenced by the conduct of affairs, are generalized. Second, the generation of resolutions using selection between prescribed options is passive while using discovery by attending to unique aspects of the stimulus is active.

This new arrangement is shown in Figure 5.5

Mode Specialized	Component Preparatory	Mode Generalized
Knowledge available to deal with specified stimuli	Distributed Knowledge **DK** The total knowledge set of the dispersed team	Knowledge available to deal with unspecified stimuli
Skills available to deal with specified stimuli	Distributed skills **DS** The total skill set of the dispersed team	Skills available to deal with unspecified stimuli
Predefined ways of working	Team Routines **TR** The accepted ways of working within the dispersed team	Emergent ways of working
Mandatory rules that prescribe actions	Occupational Rules **OR** The set of occupational statements about what activity is and is not acceptable within the domain	Advisory rules that allow for discretion in actions
Prescribed actions to be followed inflexibly	Occupational Procedures **OP** The details of how work activity is organized	Guiding principles that allow for non-prescribed actions
Externally provided special to task	Occupational Artefacts **OA** The material resources available to the team	Internally created or configured

86

Mode Passive	Component Configuring	Mode Active
Using routine, habituated interpretation of cues	Representing the situation **RS** The process by which the team reaches a common understanding of their situation	Searching for unique contingent cues
By selecting between prescribed options	Generating resolutions **GR** The process by which the team identifies practical resolutions	By attending to unique aspects of the stimulus
Acting by rote	Prioritizing actions **PA** The process by which the team selects the order in which actions will be taken	Acting in order of perceived immediacy of need
Using artefacts in specified, conventional ways	Using artefacts **UA** The ways in which material resources are used	Using artefacts in non-specified, unconventional ways
Responding to direct intra- or extra-team supervisory control	Coordinating actions **CA** The process by which team actions are coordinated	Mutually adjusting roles and activity in response to exigency and the contribution of others

Figure 5.5   Components, attributes and modes of intervening mechanism

5.5   Interim conclusions

Analysis of the data collected in the second domain of study, an Air Traffic Control Centre has informed amendments to the stimulus and response typologies (Figure 5.1 and Figure 5.2) that tidy up the terminology of rather than involve or suggest any changes to the fundamental concepts adduced in the first domain.   The synthesis of attributes and descriptors, shown in Figure 5.4, suggest a rich and increasingly applicable mechanism, stable across at least two dissimilar domains. In addition, what emerges from aggregation of the descriptors is what I have termed modes of the components.

In essence what has been revealed across two domains is the process by which responses to stimuli are configured. This appears to occur partly in advance of events by the attributes of the resourcing component and, partly as a consequence of events by the attributes of the configuring component. It suggests that the vast range of potential configurations is generated by a common mechanism, the actual configuration depending on the inter-relationships between the components and modes of the mechanism and being sensitive to the contingent characteristics of the stimulus.

Having already identified the way in which the knowledge literature has informed this study (4.4.2) I returned to the literature to see what extant theoretical perspectives might shed further light on the emerging phenomenon.

5.5.1   Situated action

In the recent past, scholars of organizational behaviour had become increasingly critical of approaches that ignored the influence of individuals and teams in configuring

organizational activity (see for example: Mintzberg, 1979; Reed, 1985; Weick, 1979, Tranfield *et al*, 1998; Entin and Serfaty, 1999). Furthermore, rather than the expression of minutely planned and rigidly defined organizational processes, much behaviour has been found to be the product of knowledgeable interpretations and judgements, in a process that is situated and as such resists prior specification (Gammack and Stephens, 1997; Lave and Wenger, 1991; Suchman 1987). The concept of situated action was first introduced by Suchman (1987) who proposed that *all* purposeful actions are situated, that is taken in the context of particular, concrete circumstances. This insight informed her view that the (then) current state of information technology rendered it impossible for a computer to respond as a human would because it was not sentiently in the situation and could therefore only make algorithmic responses. Of necessity these were planned and prescribed. At the heart of her thesis is the concept that action depends in essential ways on its material and social circumstances. In essence, she changes the focus of study from abstracted rational plans to how groups use their circumstances to achieve intelligent action. In doing so she followed the lead of Follet who, originally writing in the 1920s, suggested an early contingency notion in the *law of the situation*. Her view was that it was the situation itself that dictated actions and that managers have to take orders from it rather than impose a prescribed resolution (Follett, 1973; Graham, 1987)

As Nardi (1996) later observed, situated action focuses on the unfolding of real activity in a real setting and is very descriptive of human action and applicable to this research. Action is therefore emergent, contingent and improvisatory to varying degrees depending on its cognitive, social and material circumstances. It emerges through moment-by-moment interactions between actors, and between actors and their environments (Suchman, 1987).

This concept of situated action also contrasts with the planned nature of actions fundamental to the principles of cognitive science wherein constructs such as goals or plans are realized through ready made stipulated procedures rather than by lively and instantaneous assessment of need (Suchman, 1987). It helps to explain the view, and the emerging character of this research, that effective action depends on actors and their surroundings rather than on formal models. It also calls into question the utility of the S-O-R or S-M-R models of the symbolic interactionist perspective as descriptive of the kinds of actions revealed in this study.

Relating this to the data it is clear that stimuli provoke responses, and that those responses are expressions of a mechanism of interaction. That construction aligns with the symbolic interactionist perspective as noted above and described in more depth in Chapter 3. However, analysis of the data in Chapter 4 revealed two components to the mechanism, resourcing and configuring, which led me to expand the model to four elements: stimulus, resourcing, configuring, response. These four elements may now be integrated into a generic model of situated action, as follows.

As informants describe them, the situations they face are compounded of two facets: first, the stimulus with its objective characteristics that would be faced by any actor and; second, the basic ability of the actor to respond, based on knowledge, skills, routines, rules, procedures and available artefacts – what I have termed the resourcing component

of the mechanism. Thus complete novices faced with a demanding clinical trauma or air traffic event would be in an entirely different situation from experienced professionals dealing with exactly the same objective characteristics of the stimulus. Extending this, a team limited to specialized resourcing would be in a substantially different position from a team for which resourcing was more generalized. It is a fundamental of situated action that actions are contextualized, that is the situation is the prime factor in determining what people will do (Suchman, 1987) further that the situation can be represented as the interaction between the raw stimulus of an event and the resourcing of the group (Lubitz et al 2004).

In high velocity error sensitive domains this insight is of particular use because it ensures that any initial action is focused on the unique characteristics of the situation rather than on any rational plan (Clancey, 1993). Further, that any revision to the action will be similarly focused and therefore remain sensitive to the changing situation either as a result of an additional, external characteristic of the situation or as the initial and revised actions have an effect on the situation. This situational rather than rational sensitivity is a clear emergent characteristic of the domains in this study.

Similarly, as informants describe the responses they make, their actions are compounded of the generation of the response through representing the situation, generating candidate responses, prioritizing actions, using artefacts and coordinating action, what I have termed the configuring component of the mechanism, and the actual response they make.

5.5.2   Situated behaviour

It was useful in the context of this research to discover that Piaget (1979) was careful to differentiate between actions and behaviour. Actions he understood as being the consequences of normal psycho-physiological functions, like moving an arm. Conversely, he understood behaviour to be intelligent actions directed by an organism towards its environment with the intention of changing that environment or the organism relationship to it, like moving an arm in order to strike someone or pick something up or to point. This Piagetian notion of behaviour is therefore constituted of the intelligent generation of a response and the response itself, whether passive or active, prescribed or not-prescribed. Subsequently Lave and Wenger (1991) have demonstrated that in general the nature of a situation has a formative impact on the behaviour of an individual or group. I therefore integrated these several insights to amend Suchman's (1987) concept of situated action to one of situated behaviour. Further, I have used the components and attributes of the mechanism to establish empirical support for her espoused connection between symbolic interactionism and situated behaviour.

The empirical evidence is therefore encapsulated in a theoretical model of situated behaviour that links to the SMR model via the four elements of the interim model adduced in Chapter 4. The new arrangement and its relationship to the SMR model is shown in Figure 5.6 below.
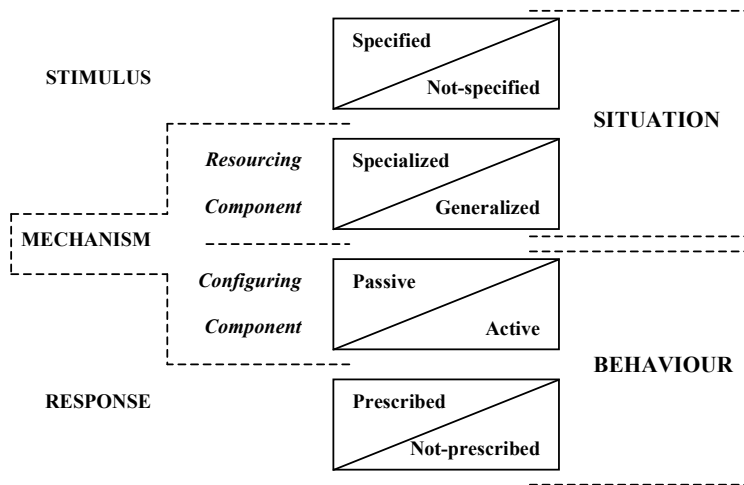
Figure 5.6   *Connecting symbolic interactionism with situated behaviour*

5.5.3   Coordination

The issue of coordination was clearly of importance to the informants as it was essential to the safe and expeditious flow of air traffic. Although in the mechanism model (Figure 5.4) coordination is expressed as being based on direct supervision or increasing levels of mutual adjustment, these two are located in the configuring component of the mechanism and are therefore focused on the activity within the domain. However, they are the polar dimensions of the continuum first suggested by Mintzberg (1979), that moved from direct supervision, where one person is responsible for the work of others, through three forms of standardization (work processes, skills and norms, and outputs), to mutual adjustment, an informal process deemed to remain in the hands of the operators (Melin and Axelsson, 2005).

Drawing further on Mintzberg (1979), the three mechanisms of standardization are in effect realizations of the influence exerted by corporate and external bodies (e.g. professional bodies and colleges, legislation and perhaps consultants or industrial advisers). As such these are influential in the development of baseline procedures, rules and routines and are most evident in the resourcing component. For example, evidence from this study (now across two domains) suggests that standardization of work processes and concomitant skills, which prescribe the content of the work, informs the development of procedures, rules and training schemes. The standardization of outputs is enshrined in the superordinate goals of 'safe and expeditious flow of air traffic' and, in the previous domain, 'to preserve life'. Whatever action is taken, these goals remain paramount. This requires flexibility in the routines, which therefore become more emergent than predefined.

These observations acknowledge the contribution that Mintzberg (1979, 1983, 1989) has made to our understanding of coordinating mechanisms and how they might be applied. However, they also indicate that unmoderated application of his mechanisms, grounded as they are in formal divisions of labour, relatively stable organizational structures and planned coordination (Larsson, 1990), is problematic in these domains.

The essential flexibility necessary in high velocity domains seems to require that the mechanisms are employed jointly and severally, in contingent rather than rationally designed combinations, that they are manifest in different components and modes of a broader mechanism (Figure 5.5) and that thus interpreted they may therefore have more in common with the concept of routines (Nelson and Winter, 1982) than with delimited mechanisms (Mintzberg, 1979).

5.5.4   Routines

As Becker (2002) notes, the basic characteristic of an organizational routine is of a recurring pattern of interaction (Nelson and Winter, 1982) however, Winter (1964) had earlier suggested a routine was also subject to change if conditions changed while Koestler (1967) suggested that routines were flexible patterns offering a variety of alternative choices. However, this pattern approach seems most applicable in predictable, low velocity, error tolerant environments where patterns not only have time to develop but can undergo controlled change. This view of controlled changed based on past experience has been supported by Cohen *et al* (1996) who say that routines adapt incrementally and Dosi *et al* (1992) who propose that the development of routines is a function of their previous state.

Thus, although organizational routines can exhibit a great deal of continuity over time (Aldrich, 1999), they are also able to change continuously under both endogenous and exogenous influences, contributing to flexibility and change (Feldman, 2000).   As a consequence, theorists have progressively developed the perspective that organizational routines are dynamic systems, rather than static objects (Pentland and Reuter, 1994; Cohen et al, 1996; Lazaric, 2000; Feldman and Pentland, 2003). Routines are now perceived as continuously emerging systems with internal structures and dynamics that can produce a wide range of contingent outcomes (Pentland and Feldman, 2002).

Pentland and Feldman (2002) propose that routines have two key characteristics – ostensive and performative – making a distinction that is important both for understanding routines and for locating the theory in this research. They propose that the ostensive aspect is best understood as abstract patterns that actors use to guide specific performances. Conversely, they propose that the performative aspect is best understood as actual performances by specific people, at specific times, in specific places. Locating these insights in this research, I propose that the ostensive aspect is embedded in the resourcing component of the mechanism as an exemplar and the performative aspect is embedded in the configuring component of the mechanism as the source of behaviour.

But perhaps the importance of the characteristics of routines is at least matched by the importance of their role. It has been a persistent theme in the routines literature that the role of routines is to coordinate (see for example Nelson and Winter, 1982; Dosi *et al*, 2000). Routines contribute to the smooth performance of tasks (Rumelt, 1995) and have the capacity to support highly varied sequences of interaction Grant (1996). Additionally, they help in rendering simultaneous activities mutually consistent (March and Olsen, 1989) by making explicit the contributions of others (Simon, 1997) to which actors can continuously mutually adjust (Mintzberg, 1979).

5.5.5 Recapitulation

The S-M-R model now integrates a number of theoretical perspectives. From 4.4.2 the influences of tacit and explicit knowledge are elaborated in the concepts of calculative and deliberative rationality (Dreyfus and Dreyfus, 1984) and inform the typology of response. Following Polanyi (1966) and Dreyfus and Dreyfus (1984) responses are therefore grounded in the clinician's tacit knowledge of their field and their use of deliberative rationality. That concept holds in this domain and is added to in a number of ways.

First, interventions are understood as manifestation of situated behaviour (sic) with the particulars of the situation guiding action in an iterative process rather than by simply following rules (Suchman, 1987). Next, that actions need coordinating leads naturally to concepts of coordinating mechanisms (Mintzberg, 1979). But in these domains these are moderated, occurring contingently and manifest in different components and modes of the intervening mechanism (Figure 5.5) and thus interpreted they may therefore have more in common with the concept of routines (Nelson and Winter, 1982) than with designed mechanisms (Mintzberg, 1979). Further, the enduring characteristics of routines (Nelson and Winter, 1992) have been refined to include more flexible interpretations as continuously emerging systems. Thus, taking up the Pentland and Feldman (2002) concepts of the ostensive and performative aspects of routines we can understand them as both exemplars for activity that reside in the resourcing component of the model and generators of specific behaviour via the configuring component.

The findings so far are therefore informed by insights from the knowledge, routines and coordinating mechanisms literature and have also demonstrated how intimately and recursively related these three perspectives can be.

5.6 Implications for the Next Domain of Study

As has already been established, teams move easily between configurations to behave in situationally sensitive ways. The process of contingent, continuous reconfiguration depends on the interaction between the resourcing and configuring components.   With a further domain available for study I decided to continue to explore this phenomenon in more detail, in continuance of the theoretical sampling concept in the grounded method.

For the third study I had provisionally negotiated access to an Explosives Ordnance Disposal (EOD) Unit of the British Army. However, operations in the Middle East supervened and this option became unavailable. Fortunately, I was able to use further personal contacts to negotiate access to another domain that shared the UHiVES context, namely a station in a regional Fire Crash Rescue service.

Prior to entering the domain I had to hypothesize on which dimension of the characteristics the FCR would be located. This hypothesis was grounded in my own experience of commanding a military fire detachment (Green Goddess) during industrial action in the fire service some twenty years previously. However, as will become obvious from the data, this proved to be a fair assessment. As I explain, and as Figure 5.7 shows, FCR domain shares characteristics selectively with each of the previous two however, no dimension is shared by all three domains. Although this ultimately was a

convenience sample it remained purposive because it shared the contextual characteristics of unpredictability, high velocity and error sensitivity and was in its particulars sufficiently different from the other domains to enable new insights to emerge. My hypothesized dimensions were as follows:

Normal operations are unpredictable since there are no explicit cues to the occurrence of a fire or rescue incident.

Activity is discontinuous because the service is almost wholly reactive and some shifts can close without being called at all.

The focus of activity is proximal because the fire fighters are in direct contact with the incident and as a consequence their interventions have direct and immediate influence on outcomes.

Team composition is initially static since it is based in formed crews for appliances, however this may become more dynamic at larger incidents

Support is largely inter-team as between crews and other emergency services

Fire fighters are generalists in the twin contexts of fire fighting and crash rescue

	A&E	ATC	FCR	Characteristic	FCR	ATC	A&E	
Predictable		X		**Normal operations**	X		X	Unpredictable
Continuous	X	X		**Type of activity**	X			Discontinuous
Proximal	X		X	**Focus of activity**		X		Remote
Direct	X		X	**Influence on outcomes**		X		Indirect
Static			X	**Team composition**		X	X	Dynamic
Intra-team	X			**Support**	X	X		Inter-team
General	X		X	**Qualifications**		X		Special

Figure 5.7   Differentiating characteristics across three domains

CHAPTER 6

RESULTS FROM A FIRE CRASH RESCUE UNIT

6.1   Introduction

In this chapter I present the results from the third domain of study, a Fire/Crash Rescue station within a regional Fire Service. In common with the previous domains I provide in this section a description of the regional service and then the station that was the focus of the study more particularly. I then offer in Section 6.2 some short observations on data collection and analysis methods in the light of the outcomes of the first two studies. In Section 6.3 I distil the key examples of the data within an integrating narrative. I then progress in Section 6.4 to analyze the data and I conclude in a review of the outcomes that I have achieved theoretical saturation of the concepts and categories germane to the emerging theory.

6.1.1   The Role of the Regional Fire and Rescue Service

The regional fire service in which this study took place is located in the North of England. It is responsible for a large mixed rural and urban area, with a variety of domestic properties but also includes what are referred to as high-risk installations. These embrace industrial sites, especially petro-chemical installations, factories, hospitals, schools, National Trust and similar properties, and airfields.

In addition to dealing with fires and other emergencies the fire service, as part of a national resource, enforces fire safety laws, offers advice about fire safety and contributes to a number of emergency-planning activities. The service is subject to a range of governance by both legislation and guidance, the defining act is the Fire Services Act 1947 (to be superseded by the Fire and Rescue Services Act 2004, due in October 2004) that requires fire authorities to make provision for fire fighting purposes, which means not only putting out fires but also protecting life and property in case of fire.

It was a surprise to me to discover that it is not a legal requirement for the service to provide any non-fire rescue services, such as attendance at road traffic accidents, assistance with domestic flooding and saving stranded animals. Each of these is reviewed on a case-by-case basis and depends on the equipment and manpower available and other priorities. The service provides support in the five key areas briefly described below, but of most direct interest to this study are the two response services that the service provides, namely fire/rescue emergency response and special services**.**

Community Fire Safety recognises that prevention is better than cure and covers a range of initiatives aimed at reducing the number of fires, the number of deaths and injuries, and the damage to property caused by fire.

Legislative Fire Safety reduces the risk from fires in the workplace and similar buildings, by monitoring compliance with fire safety legislation and issuing fire certificates when compliance is achieved.

Emergency Planning incorporates planning and preparation for large-scale emergencies, for example, large rail crashes, coastal pollution, severe floods.

Fire and Rescue Emergency Response is the service perhaps best known to the public and almost defines the Fire Service in their eyes. It comprises the responses to incidents to minimize the risk of injury, loss of life and damage to property.

Special Services comprise responses to other types of incident, for example, vehicle accidents, trapped people and animals, storms and floods. As previously stated attendance at these events is discretionary and the service is also at liberty to charge for some of these services.

The whole of the service is well equipped with the latest fire fighting and personal protection equipment.

6.1.2   About the Station

> *Note: With the late withdrawal of the EOD Unit I was able to use personal contacts to negotiate late access to this Fire Service. However, as with A&E and for similar reasons, they requested anonymity for both the service and the individuals who kindly agreed to be interviewed. Again my judgement was that free access to valuable informants was more important to the research than the need to identify my sources directly.*

The Station is located in a city and is collocated with the Command Headquarters and the central control room. The headquarters has command and control responsibility for the whole service while the control room is responsible for the allocation of operational resources to incidents and is the central clearing house for all operational communications. Although collocated, the station operates as an autonomous unit within the service and is commanded by a Station Officer. It serves a large cross section of premises and risks including densely populated residential, office, retail and industrial properties. The station covers some of the largest life loss risks such a hotels, hospitals and sporting venues. At this station the key vehicles are two rescue pumps. Each vehicle has a crew of five. The station establishment is 52 all ranks split between four shifts. They deal with some 1400 incidents per year, responding also to some 1300 false alarms. These latter are in general well intentioned rather than malicious calls.

Each shift begins with roll call, when each fire fighter is given their orders for the shift and allocated to a specific role, known as the riding position, if called to an emergency. The positions are rotated so that all the crew gain experience of the different functions. The only exception is the officer in charge who always leads that crew. The ride positions and their roles are as shown in Figure 6.1.

> **Position 1** - Officer in Charge front - Passenger Seat
> **Position 2** - Driver – Driving seat
> **Position 3** - Breathing Apparatus Team - back seat near window
> **Position 4** - Breathing Apparatus Team - back seat near window
> **Position 5** - Breathing Apparatus Controller and waterman - back seat centre

Table 6.1   Crew riding positions

Unlike A&E and ATC where operations are continuous, in a Fire Station the crews await call-out. The waiting time is divided between a number of drills and duties. Drill refers to a wide range of exercises designed to practice different fire fighting techniques or become familiar with new technology, new procedures and new hazards. These might include exercises using breathing apparatus to rescue a trapped person or a lecture on hazardous substances. This is also the opportunity to learn about any new or special equipment that they may have to use at an incident. General duties include checking all the emergency equipment on board the fire tenders as well as general maintenance of the vehicles. Crews may engage in community fire safety initiatives like home fire safety visits and school educational visits, fit smoke alarms in houses or show school children around the tender. The whole crew goes out together as a unit with the tender. The driver stays with the vehicle so that if there is a call out, the others can be summoned with the siren and the crew can respond immediately.

6.2   Data Collection and Analysis

I undertook interviews and observations in the station between 8 May and 5 June 2004. The health and safety regulations pertaining to the carriage or involvement of non-trained personnel during actual incidents are strict and so, my direct observation opportunities were limited to two occasions. I was able to observe crews dealing with a factory fire and a road traffic accident, having been transported to the incidents in a utility vehicle however, I was also granted access to training drills. I was also allowed free access to the central control room and was therefore able to monitor the way that incidents evolved even when I was not present. With each crew totalling five fire-fighters I interviewed two crews and an operations controller. I had access to the informants shown in Table 6.1.

Informant	Code	Role
Station Officer	StO	Fire Station Commander responsible for the general operational and administrative efficiency of a Fire Station with several subordinate watches
Sub-Officer	SO	Watch Commander at a Fire Station who may also act in a staff role or as an inspecting officer for some levels of fire safety inspection work
Leading Fire-fighter x 4	LF1 LF2 LF3 LF4	Senior fire-fighter who is normally the officer in charge of a crew or appliance
Fire-fighter x 4	FF1 FF2 FF3 FF4	First rank in the Fire and Rescue Service who is normally the member of an appliance crew
Operations Room Controller	ORC	Support staff who receives emergency calls from the public, mobilises provides ongoing support to incidents

Table 6.2   Key Informants

On a number of occasions prior to beginning interviews, I was able to observe activity in the operations control room and during training, to a total of 23 hours non-participant observation throughout the study. Again, this served as orientation and immersion rather than formal data collection although I did make some contemporaneous field notes.   Being totally new to the environment this proved most helpful in understanding the general setting as well as clarifying more particular events and provided the basis for interviews.

I conducted all 11 interviews, averaging 70 minutes duration, predominantly off-shift so that the response to incidents did not intervene. Again I adopted a loose structure, to reveal those phenomena that the informants considered significant in their work, with regard to the events to which they responded and the responses they made.

6.3   Domain Narrative

It is evident from the description in Section 6.1 that the breadth of responsibilities placed on the Fire Service is broader than in the other two domains; the education, certificating and enforcement programmes the service delivers are examples. However, for the purposes of this study the two significant areas of service provision are the emergency response and special services. The essentially emergency response nature of the fire service domain means that high velocity and error sensitive events are more intermittent than in the other two domains, where continuous operation is the norm. However, since it is just these events rather than their frequency of occurrence that form the focus of the research, the domain represents a relevant, differentiated opportunity. The research in this domain therefore focused on the extent to which new data might amend the concepts that had already emerged from the previous domains especially in the context of situated behaviour.

Throughout the interviews it was clear that the types of stimulus and response, characterized by an idealized type and an unlimited range of divergence, established in

the previous analyses, remained stable in this domain. For example, the notion of specified stimulus was expressed quite simply.

> 'We have got fairly standard types of call-out, house fires, minor industrial, dangerous chemicals, road accident, cat up a tree, etc. All well pretty well described in general terms and the sort of thing what all of us have been trained for and most of us have experienced in incidents.' (FF2)

Equally, such specificity as even these generally recognized terms signify is rarely encountered in all its particulars. Indeed, the specificity is essentially a simulacrum, with the reality of each situation being evidenced by difference from rather than similarity to the implied norms. One fire fighter put it this way:

> 'But they are only a guide really. Imagine the number of different situations the simple terms house fire or road traffic accident might cover. So there is no foolproof way of knowing what an incident is or deciding how an incident is going to pan out. Sometimes it is simple, but often when you get to the incident it isn't quite what you expected. Or once you start dealing with it something else happens, highly combustible material ignites, or perhaps someone is reported as still in a building, or a piece of equipment goes down. In road accidents the obstruction can cause other accidents while you are dealing with the first one.' (LF1)

The variations from whatever might be specified can indeed become extreme, to the point of being wholly unique in the experience of the fire fighters, as for example in this description of a major train crash.

> 'When we arrived there were two trains which had obviously hit each other at speed, wreckage everywhere, people seriously injured, others wandering around in a daze, well meaning by-standers trying to help, pretty confused situation really. It's the enormity of the situation that hits you not the individual bits. Even to experienced men it is totally different from what you have seen. Where do you start?' (FF3)

However, the notion of situation being more than simple stimulus also emerged at an early stage. As one informant expressed it:

> 'Let me give you an example of what I am saying. A waste-paper basket fire in an office is a different problem depending on the knowledge of the person involved and the availability of fire appliances. Is the person a trained fire-fighter with an extinguisher or fire blanket, without an extinguisher, an untrained office junior with an extinguisher, without an extinguisher? The options are pretty numerous and each one is a different situation, but the fire is the same. If the fire is bigger, are the individuals used to working together to cope. Professionals yes, others well perhaps not.' (LF4)

This contrast between essentially untrained people and professional fire fighters while illuminating as an example was made more compelling when placed firmly in the professional field by another informant.

> 'All sorts of things could affect the situation even for us, everyone has the same basic training proficiency but the broader experience of individual crew members affects it and what the crew can do to some extent. Of course the rules and procedures help but we use a lot of our training time to ensure that crews work together as much

instinctively as by instruction. And of course we have all our equipment. But, even in a supposedly standard situation, say a house fire, you have to still focus on what is actually going to decide what the situation really is. (FF3)

Once again, therefore, it emerges in this domain that the fire fighters acknowledge what in theoretical terms is an ideal type of stimulus in the sense of an attempt to describe in a helpful way what types of incident they are most likely to encounter. However, experiences in their everyday work vary in significant ways from the ideal and therefore represent situations that are highly differentiated both from any rational concept and from much previous experience.

Similar evidence emerged relating to responses. Although some responses appeared to have an element of idealization in the selective use of, for example, prescribed options and artefacts under direct supervision, all clearly demonstrated the use of divergent activity, as the following extracts demonstrate.

The fact that rules and procedures guided responses was immediately evident, although these again tended to refer to lower level operations that could be combined in creative ways.

> 'We have rules and procedures for level of response, appliances and crews, equipment operation, pumps, breathing equipment, extractors, liaison with other services that sort of thing. Years of knowledge and experience go into them and we update them. They can save time and effort in normal operations. But at the end of the day it is what is in front of you that matters and how you can best deal with it with what you have got.' (FF3)

An example of a prescribed response based on preparatory thinking and general preparedness is reflected in what is known as predetermined attendance (PDA) on which all formal responses to emergency calls are based; this means that the number and type of appliances sent in response to an initial call has been predetermined. But even this is only a first approximation of need. Once there is an incident commander on the scene this response will be reduced or augmented, as the incident requires. The ability to augment depends in turn on the availability of appliances in contiguous areas, including those of other independent services, and the availability of crews. As the operations room controller explained it:

> 'When we get a call, we will normally send two appliances and bring others to readiness. We expect to be able to send each appliance fully crewed but we may be some crew short. We can still despatch the appliance but we need to bring others in because the number of fire fighters available is as important as the number of vehicles. So, if I have a PDA of 2 and one of those is under-crewed I have to send 3 appliances, which means bringing one in from another station, that affects the broader resource considerations because you are using more than you really need to just to achieve minimum cover.' (ORC)

However, the imposition of these formal procedures appeared not seriously to constrain the manner in which fire fighters behaved in particular situations. The notion of situated behaviour quickly emerged, evidenced in this example of the use of material and human resources:

'If you take the procedures as a framework that we can work in, you also have to consider how the actual situation you are attending might be different from any standard. So when you get to the incident you might have to call up more assistance, or stand an appliance down, use standing water rather than a hydrant. Some installations like factories, airports and stately homes have their own rapid response teams, you have to fit together. You are always looking for the best way to deal with the incident whatever it is and whatever you can use.' (LF2)

Another example of a tacit understanding of situated behaviour emerged from a description of how incident specific routines developed, which may never be used in exactly the same way again:

'When you attend a road accident you will have fire, police, paramedics as a minimum. Right, we all have our own procedures, but sometimes the priorities conflict, so you have to make accommodations on the spot. Instead of sticking rigidly to individual service procedures, you concoct a way of working that uses what procedures it can using the best from each service but takes account of the realities of the situation. You join things up as best you can.' (LF3)

A more specific illustration came from another experienced fire fighter, reporting an incident that I subsequently discovered resulted in the award of a commendation. It served to demonstrate how what might otherwise be a routine incident might require a creative response. In this case a fire in a shop following a minor gas explosion resulted in independent, unaided albeit professional action.

I was off duty and walking near a shop when there was an explosion. I told a passer-by to dial 999. Got into the front of the building and got one guy out. I had to put the flames on his clothes out with my hands. I looked after both casualties until the fire and paramedics arrived and kept the public away from the fire. Unfortunately, the bloke died two days later from his injuries. Now a fire in a shop, if I had responded with the crew is pretty standard stuff and we have the kit and the procedures to deal with it. But when you have nothing, you need to be a bit inventive. You have to do something. You can't just walk away or stand and watch. (FF4)

In a less dramatic example, another fire fighter demonstrated how inventive if unspectacular use of available resources stops a situation becoming more extreme. Called to a lake to rescue a poor swimmer who it transpired was still suffering from injuries sustained in a previous motorbike accident and who had fallen from a dinghy, the fire-fighter reported.

'When we got there the chap had been in the water for about 25 minutes. He was suffering from hypothermia and was having difficulty breathing. We put him on oxygen and put him in the appliance for protection. We had requested an ambulance but none was available, so in the end I decided to take him to hospital on the fire appliance. (FF2)

A clear summation came from the sub-officer acknowledged the usefulness of basic rules etc., but emphasized that the uniqueness of an incident was often enshrined more in its dynamics rather than any initial condition and that the situation as it evolved dictated the behaviour of the crews.

'Even when you go to a call that is pretty unique, there are basic rules to help. But these things are dynamic and I find it is the dynamics rather than the initial situation that dictates what you do. By the time you are really stuck in, most of what you are doing and using and the way you have got the team grouped up isn't in the book or inventory. It's your knowledge and training and experience and what is actually happening, mostly on a moment by moment basis guides what you do.' (SO)

These are representative of a broad swathe of data that reinforces the basic types of stimulus and response already adduced in the previous two domains as having idealized foundations but unique characteristics. They bear witness to the fact that the fire service prepares in the best way that it can in order to be able to respond to incidents but that what is required in all incidents is be ready to deal with the circumstances that prevail and not some preconceived idealization. The concept of situated behaviour therefore gained more support.

Evidence as to how this situated behaviour was engendered became clear when it was explained that through formal training and simulation fire fighters are intended to construct responses (behaviours) that are relevant to the situation they face. This suggests that these simulations are focused on the development of flexibility rather than ever more rigid adherence to procedure.

'When we run training, sometimes we are just making sure that people know all the basics of appreciation, use of equipment, liaison with other attendance etc. But when I run an exercise I am more interested in crews being alert to the specifics of the incident and using their nous as to what to do. The stuff you learn at the basic level is important but only as a contributor to a much more total response.' (StO)

Fire fighters clearly work in potentially very dangerous environments and the need to develop and continuously to update a common understanding of the situation is deemed by all informants to be paramount. As one fire fighter explained:

'In a major incident there is pandemonium, often lots of noise and you may be out of visual and speech contact with each other. So we develop ways of working together that are flexible but are to some extent fairly predictable. You use all your experience and knowledge to try to sort the situation out then your skills to actually do something about it. This can be dangerous stuff and so you have to depend on your mates for your own survival as well as helping any casualties. You get a buzz but it comes at a price.' (FF2)

It was also evident that especially in serious incidents that call forth a multi-service response the need to coordinate both within and between services remains critical. The wide range of variables that might constitute the situation having a direct bearing on the behaviour that emerged.

'The environment is always hostile, fire, chemicals, fuel, but we have some pretty good kit, personal equipment as well as the appliances and there are other units, the police, paramedics, some installations have their own response teams and we have to coordinate with them. Procedures are important of course but basically we are paid to make decisions on the spot not just look for and follow procedures.' (LF4)

The sub-officer's words serve to emphasize the essential team-based manner in which the situation is continually assessed and behaviours matched to the agreed representation. They summarize the process by which behaviour is uniquely constructed from the situation and how, in this example, the art of *bricolage* (the ability to make do with the resources to hand) can be important.

> 'Appreciating the situation as a team not one guy thinking and the rest waiting for orders, then agreeing about what you can do. What comes first: lives before property, public before the crew, safety before intervention. You concoct ways of working that suit what is happening, you are always resource limited to some extent so you beg, borrow or acquire just so long as you can keep the thing under control. It's not so much what else you can use an appliance for it's more how you can use immediately available resources to augment your own equipment. I once had a decommissioned appliance towed from a government surplus trader's yard so we could use the pumps. (SO)

What emerged from these and similar data extracts supported the previously adduced notion of a mechanism with two components that produces responses to stimuli. Clearly evident also was a tacit concept of situated behaviour, with the situation comprising the stimulus as moderated by the resourcing component and the behaviour comprising the response as produced by the configuring component.

A final word from the station officer encapsulated the significance of situated behaviour especially in dynamic situations.

> 'In spite of all the rules and procedures, the formal basic and continuation training and what is amongst the best kit available to fire fighters anywhere, it all comes down to being able to assess what is happening on its own merits and to respond accordingly. When you are in a fast moving and often very dangerous environment, you have to know what is happening from minute to minute and to be able to change your response very rapidly and appropriately. In my view you can only do that if you are continuously aware of what is happening and what the realistic options are

6.4   Domain analysis

Analysis of the data from this domain revealed a broad range of examples that accorded with the typologies of stimulus and response previously adduced with no disconfirming examples. Similarly, the components of the intervening mechanism were supported, with no need to add new attributes nor to amend the current attributes. I included some examples to support this assertion early in the narrative.

Tracking the concept of situated behaviour that had emerged from the previous two domains, my narrative concentrated on the extent to which that concept was supported. I therefore introduced evidence that demonstrated how this concept is tacitly held and understood by the informants. Specifically, the data lent support to the hypothesized connection between stimulus and the resourcing components as situation and similarly to that between the configuring component and the response as behaviour. It also demonstrated that I had revealed a de facto literal replication across the three domains.

However, the introduction of the term bricolage in the narrative needs explanation and a theoretical setting since, although marginally evident in the previous two domains (A&E, ATC) this was the first time that serious bricolage concerning material resources was introduced. As I shall explain, bricolage is closely related to improvization and I shall use improvization as the broader theoretical setting.

6.4.1   Bricolage and Improvization

The concept of bricolage originates in the work of the social anthropologist Levi-Strauss (1966) and is reflected in the work of De Certeau (1984) and Weick (1993). De Certeau (1984) sees bricolage as artisan-like inventiveness embracing a variety of tricks, ruses, and creative practices in which individuals and groups indulge. Cunha (2005) emphasizes the radical differences between the bricoleur and the rational resource planner, as commonly portrayed in the literature. Whereas rational planners act by departing from the structure and applying abstractions to events (what resources will be necessary to deal with this situation?), the bricoleur departs from the event to build a structure that makes him/her able to solve the problem (how may this event be approached with these resources?).

Weick (1993) describes bricolage as using whatever resources and repertoire one has to perform the task one faces. He suggests that this derives *inter alia* from intimate knowledge of resources coupled with close observation of events and a strong trust in one's own intuition. Weick's (1993) concept draws on Levi Strauss (1966) who suggested that the key to understanding the nature of bricolage is that resources are deemed to be useful because they are first of all known about rather than coming to be known as a result of use.

The example of the station officer who used a decommissioned appliance exemplifies this, as does the example of the use of elastic bands as ligatures and staples as sutures by the consultant in A&E. According to the informants, in both cases it was intimate knowledge of the resource and its availability that led to its use rather than a hopeful assumption that some resource might present itself. This resonates with the example cited by Berry and Irvine (1986) that, faced with the task, say, of repairing a faulty machine, the bricoleur looks over the material at hand and improvises a solution, thus articulating a bricolage/ improvization relationship.

However, the concept of using whatever resources and repertoires one has to hand must necessarily include having everything one needs, as in all three domains is frequently the case. Thus the power of the concept of bricolage in the context and domains of this study lie in the artisan-like inventiveness (De Certeau, 1984) with which resources are used rather than their relative paucity. Taken together these perspectives lead naturally to a discussion of the concept of improvization.

A working definition of improvization may be taken from jazz music, where it entails composing and performing contemporaneously (Hatch, 1997a). Although illuminating, the jazz metaphor can easily become over extended in the context of organization studies. For example, Bastien and Hostager (1988) drawing on Emery and Trist's (1975) notion of 'turbulence', suggest that jazz is a turbulent task environment that

results from the dynamic process of musical invention and the dynamic process of coordinating invention. Thus the turbulence originates in the improvization process. Conversely, in organizational studies it is the environment that is seen as more or less turbulent and improvization as a potential resolution (Brown and Eisenhardt, 1997).

Within organizations, improvization captures the conception of action as it unfolds, without the benefit of elaborate prior planning and the unexpected discovery of solutions, often in times of crisis (Cunha et al. 1999).   In this context, the actions of crew members to save a ship whose navigation system had malfunctioned (Hutchins 1991) and the rescue of Apollo XIII by NASA scientists working with unfamiliar concepts (Lovell and Kluger 1995) are luminous examples.   Weick (1989, 1993) has explored the concept and its consequences for organizing especially in the context of risk mitigation in disasters where decisive and unplanned action is required. Together, these perspectives reflect the general context of this research and support the theoretical relevance of improvization in explaining empirical phenomena.

In each domain of this study, there has been strong evidence of frameworks of rules and procedures: the protocols of the Royal Colleges for clinicians, the Joint Aeronautical Regulations for air traffic controllers and the Home Office regulations for fire fighters. Equally, in each domain high levels of discretion have been evident in the goal orientation of their purposes – to preserve life, the safe and expeditious flow of air traffic and the protection of people and property – and in the behaviour of informants. Further, the data abound with specific and cognate examples of revolving leadership and unusual tools and procedures.

These findings are theoretically informed by the general notion that improvization does not exist in a vacuum. Charley Mingus, the famous jazz bassist and composer, is reported as having said that you can't improvise on nothing, you have to improvise on something (Kernfeld, 1995). Similarly for organizations, Eisenberg (1990) observes that improvisation is only effective within in a framework of well-defined, simple rules and roles while Brown and Eisenhardt (1997) understand this as semi-structure that combines guidelines of varying specificity with high discretion. Kamoche and Cuhna (2001) suggest that the semi structure serves as a template upon which improvisation can take place and can include such manifestations as revolving leadership to experimenting with unusual tools and procedures.

Further evidence in this study demonstrates that informants have a bias for action as a basic resolving process, indeed the rate of activity in each domain is such that procedural and improvized behaviours form a complex integrated whole. However, detailed and open communication between close and extended team members demonstrate that all actions are carefully considered and insofar as time pressures allow agreed. Notwithstanding the framework of procedures and rules within which activity is generated, it is an empirical homogeneity across the differentiated domains, and by extension to the general context, that activity is characterised by a seamless and effectively instantaneous process of designing and enacting unprepared behaviours.

The theoretical context for these findings resides in Moorman and Miner (1995) who argue that improvisation has three key features. First it is active, that is to say

improvization emerges from actions and is itself activity based. It is by definition impromptu that is to say unprepared. It is deliberate that is to say balanced and not impulsive.

Although evidentially not the sole behaviour pattern in these domains, the incidence of improvization, as grounded in the preceding theoretical insights, is revealed as high. This can be understood under the joint contextual characteristics of unpredictability, high velocity and error sensitivity (Eisenhardt, 1989), risk mitigation in disaster (Weick, 1993) and the need to find solutions in times of crisis (Cunha et al. 1999). However, Crossan *et al* (1996) and Perry (1991) extend the concept of improvization to strategic issues citing the flexible, open, and unpredictable nature of the business environment. A suitable theoretical bridge spanning strategy, improvization and the outcomes of this study resides in the concept of dynamic capability.

6.4.2   Dynamic capability

Dynamic capability (Teece *et al*, 1997) is an extension of the resource-based view (RBV) of the firm (Barney, 1991). The RBV draws on the Penrose (1959) concept of firms as collections of resources rather than being simple administrative units. By taking an inside-out perspective on sustaining competitive advantage and linking this to idiosyncratic resources both RBV and dynamic capability represent important contributions to the strategy literature. However, they are not unproblematic.

For example Bowman and Ambrosini (2003) elaborate the concepts of the resource-based and dynamic capabilities views into a bounded repertoire of six distinct modes of resource creation: reconfiguration of support activities, reconfiguration of core processes, leveraging resources into other areas, integrating resources, encouraging learning and provoking learning. While they suggest that each represents a discrete capability and therefore resource strategy; they also conclude that in many cases organizations are unlikely to be able to adopt more than one capability.

Eisenhardt and Martin (2000) note that while dynamic capability describes the manner in which individual organizations variously integrate, reconfigure, gain and release resources, the apparent heterogeneity of this perspective camouflages homogeneity across organizations, manifest for example in best practice, thus compromising competitive advantage. Further, a key challenge to both RBV and dynamic capability is that sustained competitive advantage is in any case unlikely in fast moving environments (D'Aveni, 1994).

Bowman and Ambrosini (2003) helpfully argue that in order to extend theoretical concepts it often useful not to draw too clear a distinction between levels or purposes and instead to focus on the more fundamental principles involved. Following this lead, I contend that the fundamental principle that underpins dynamic capability does not have a strategic focus.

In support of this general contention, Ghemawat (2001) suggests that a general dynamic capability might therefore be expressed simply as the ability to renew, augment, and adapt. Zollo and Winter (2002) view dynamic capability as a learned and stable pattern

106

of collective activity through which an organization systematically generates and modifies its operating routines in pursuit of improved effectiveness. Elaborating on this, Ferdinand *et al* (2005) suggest that dynamic capabilities are relevant at all times not just when dealing with dramatic events and that they focus on operating routines rather than vague competencies. Eisenhardt and Sull (2001) and Eisenhardt and Martin (2000) identify the need in high velocity environments for these routines to be relatively simple rather than complicated, experiential rather than analytic and iterative rather than linear. None of these descriptions necessarily entails a strategic focus, although they will have strategic implications.

Throughout this study, the reports of informants and the adduced models, add empirical evidence for the key elements in this latter paragraph, as it represents the current state of the dynamic capability conversation. Specifically, the notions of reconfiguration of resources using simple routines in high velocity environments is evidenced in the components of the model of intervening mechanism (Figure 5.5) which suggests either an alternate or a more generalized concept of dynamic capability. Indeed, since the trajectory of the dynamic capability conversations appears to be away from quasi-enduring strategic competencies towards quasi-strategic operational routines the literature provides a useful theoretical framework for the findings in all three domains.

The strategic focus of dynamic capability and the relatively long timescales of development and utilization suggest that previous studies in this area will have nothing to say to the very high velocity environments represented by the domains of study. However, it is fundamental to Pettigrew's (1974) concept of extreme situations that learning here is likely to be transferable to more benign situations. There are already indications contributions to dynamic capability will emerge from this study.

6.5   Theoretical saturation

The point of theoretical saturation in grounded theory is described as when no new categories or properties are found, a point that is recognizable when continued analysis of data and the instances that they reveal simply replicate categories, and any attendant lower level properties or higher level concepts, with no need to amend definitions or descriptions (Partington, 2001). Paraphrasing in the context of this research then, the data from this domain provided considerable and illuminating evidence that supported previous notions regarding typologies of stimulus and response, components of the intervening mechanism together with their attributes, the relationship between stimulus and the resourcing component as situation and the similar relationship between the configuring component and response as behaviour.

However, my analysis of data from this domain revealed no evidence to suggest that any changes were required to the model of situated behaviour previously adduced and explicated. Taken together with the de facto literal replication achieved across three dissimilar domains this provided strong evidence that the concepts on which the model was based are stable. I therefore argue that at this stage I had achieved theoretical saturation and that as a consequence it was not necessary to seek further evidence in these or additional domains.

CHAPTER 7

SUMMARY ANALYSIS AND THEORY DEVELOPMENT

7.1   Summary of the research

I engaged in this study in order to investigate the widely experienced but poorly researched phenomenon of response configuration in extreme contingencies. I sought to reveal the mechanism by which autonomous responses to unpredictable circumstances were configured. I reasoned that this mechanism would be most evident in extreme contingencies and interpreted extreme as high velocity and error sensitivity.

I elected to study three domains that displayed a number of theoretically significant differences. This theoretical replication logic was based on an assumption that such dissimilar domains presented the opportunity to reveal interesting variations of expression if they existed.

Given that my intention was to build rather than test theory in an under researched area I elected to adopt a grounded theory epistemology. Seeking to reveal the mechanism by which responses were configured rather than a taxonomy of response archetypes I worked within the critical realist multi-level ontology.

As the research progressed it transpired that precisely same the configuring process was evident in the three dissimilar domains. I concluded that this reflects the common context in which the research was set, that of unpredictable, high velocity, error sensitive environments. Nonetheless it was interesting to note that such commonality exists across what are in their particulars such different domains.

Thus, although my replication logic was initially theoretical, that is to say one that would allow differences to emerge, the outcomes demonstrated a de facto literal replication in that the findings identify no theoretically significant differences in configuring behaviour between the domains. Also, by working from an initial theoretical framework and by being explicit about the grounded approach to data collection and analysis within and between the three domains, I have been able to illustrate both the process and how I adduced the theoretical connection between the domains, with regard to situated behaviour.

As a consequence, I judged that the traditional approach to cross-case analysis in which the fundamental connections between within-case and between-case data sets are finally revealed (Harrison, 2001) was inconsistent with the grounded approach I had adopted. Following Glaser's (1992) guidance for theory development through constant comparison and theoretical sampling I judged that the issues normally adduced in cross-case analysis had been addressed. What follows therefore represents a summary of how the attributes, components and modes of the mechanism emerged and an exposition of how these have been integrated into the final theoretical model. As a provocation to further research I also include a number of propositions that the data suggested.

7.2 Typologies of Stimulus and Response

It was intuitively persuasive and yet methodologically questionable at the beginning of the research that a relatively limited repertoire of both stimulus and response archetypes might emerge. As became clear early in the first domain (A&E) although there were some indicators of archetypal forms, attempts to identify these in any compelling way proved elusive. The first issue was that it was not possible to identify meaningful boundaries between the tentative candidate archetypes. The second, connected and more interesting, issue was that attempts to identify archetypes did not in fact reflect the experience of the informants. As the collection/analysis cycle progressed it became obvious that informants identified their work as a practically unbounded range of unique events. This uniqueness resided in the particulars of such variables as the injury/sickness, the age, sex, ethnicity, general health, psychological state etc of each patient in a spectrum that defied any but the most superficial categorization. The only significance that I could place on the necessarily high level of abstraction involved was statistical in that it would be possible to say how many fractures, or heart attacks or knife wounds or concussive injuries had been dealt with. Even at this unacceptably high level of abstraction the number of potential archetypes promised to be extreme.

This held true in the other two domains were little evidence of meaningful archetypal forms emerged. Thus the reality of informants experience was that any attempt at archetypal categorization might be theoretically useful but practically redundant. Indeed the best interpretation of all the data proved to be of a single rational conception of what might constitute a stimulus accompanied by the acknowledgement that this simply defined a datum from which an apparent infinitude of variation extended. This was interesting but not disappointing. It pointed to the notion that in the UHiVES context as exemplified in the focal domains, unique characteristics were more significant in defining stimuli than any prescription.

This led to the typology shown below that was empirically derived but informed by the Weberian (1947) notion of ideal type as exemplar (Specified **Ss**) rather than average or summary term coupled with Aristotelian logical concept of A (Specified **Ss**) : not-A (Not-specified **Sn**).

Element	Code	Type	Description
Stimulus	**S**		An event that provokes an initial, or a change of, response from the team
	Ss	Specified	A stimulus that has been rationally conceived and described, informed by but not the average of previous experience
	Sn	Not-specified	A stimulus that has not been rationally conceived and described because of unpredicted characteristics

Figure 7.1   Typology of stimuli

Similarly with responses, no evidence of meaningful archetypal responses emerged from any of the three domains. Giving due regard to the uniqueness element so evident in descriptions of stimuli this was not surprising. Intuitively, and as supported by the data, if the best representation of stimuli was an exemplary datum from which a range of variation extended then this suggested a concomitant representation of responses. Following the same Weberian and Aristotelian logic as above produced the typology of

responses shown in Figure 7.2 with ideal type (Prescribed **Rp**) coupled with Aristotelian concept of A (Specified **Ss**) : not-A (Not-specified **Sn**) as range of possibility.

Element	Code	Type	Definition
Response	**R**		An intentional initial, or change of action
	Rp	Prescribed	A response made in accordance with rules and procedures
	Rn	Not-prescribed	A response configured within a general framework of guidance

Figure 7.2   *Typology of Responses*

7.2.1   Improvement opportunities

I noted in the first two domains specific instances of data that related to improvement opportunities and undertook to include a comment in this section. The reason why improvement opportunities did not find a place in the preceding typologies was because although they may have been unexpected they were not in and of themselves high velocity and error sensitive. Rather, they were outcomes of more representatively UHiVES phenomena. However, it was interesting to note that several informants were seized of the opinion that it was the immediate, obvious and unavoidable consequences of their actions in UHiVES domains that brought into high relief the need for improvement, albeit that these would be introduced in a more rational and resourced way. This is a valuable insight and raises an interesting opportunity for further research to which I shall speak in Chapter 8.

7.3   Intervening mechanism

The research initially invoked a symbolic interactionist (Blumer, 1969) perspective, which was consistent with the origins of grounded theory epistemology (Glaser and Strauss, 1967), the critical realist ontology (Bhaskar, 1975) and the espoused purpose of the research - to reveal the process or mechanism by which responses were generated.

The eleven attributes of the mechanism adduced in the first domain (A&E) were subsequently amended to reflect the data collected in the second domain (ATC) and in turn supported without the need for further amendment by the data from the third domain (FCR). The attributes thus revealed also were found to fall into two discrete but related components. A resourcing component that essentially constituted the professional preparation of the teams for employment in their domain and the configuring component that comprised the instantaneous actions that generated responses. The configuring component was founded on the resourcing component to produce responses that were traceable to both but, except in their idealized forms, were not reducible to either and therefore not susceptible to prior specification substantiating the essentially creative process that the data revealed.

The key advantages of the model (shown in Figure 7.3) were thus stability across all domains and consistency with the related notions of ideal type and potential for variation evident in the emergent modes. This proved to be a useful interim classification because when combined with the typologies of stimulus and response it

111

provided the link between an initial symbolic interactionist perspective and what emerged as a more representative situated behaviour perspective.

The symbolic interactionist perspective is most useful when the focus of research is the interactions between people. However, it is thereby hampered from wider application by its core focus on those cognitive attributes that govern the peculiar and distinctive character of interactions that take place between human beings (Blumer, 1969). As became evident, and is shown in Figure 7.3, the attributes of this model included non-cognitive attributes in both components.

Mode	Component	Mode
Specialized	**Resourcing**	**Generalized**
Knowledge available to deal with specified stimuli	Distributed Knowledge **DK** The total knowledge set of the dispersed team	Knowledge available to deal with not-specified stimuli
Skills available to deal with specified stimuli	Distributed skills **DS** The total skill set of the dispersed team	Skills available to deal with not-specified stimuli
Predefined ways of working	Team Routines **TR** The accepted ways of working within the dispersed team	Emergent ways of working
Mandatory rules that prescribe actions	Occupational Rules **OR** The set of occupational statements about what activity is and is not acceptable within the domain	Advisory rules that allow for discretion in actions
Prescribed actions to be followed inflexibly	Occupational Procedures **OP** The details of how work activity is organized	Guiding principles that allow for non-prescribed actions
Externally provided special to task	Occupational Artefacts **OA** The material resources available to the team	Internally created or configured
Passive	**Configuring**	**Active**
Using routine, habituated interpretation of cues	Representing the situation **RS** The process by which the team reaches a common understanding of their situation	Searching for unique contingent cues
By selecting between prescribed options	Generating resolutions **GR** The process by which the team identifies practical resolutions	By attending to unique aspects of the stimulus
Acting by rote	Prioritizing actions **PA** The process by which the team selects the order in which actions will be taken	Acting in order of perceived immediacy of need
Using artefacts in specified, conventional ways	Using artefacts **UA** The ways in which material resources are used	Using artefacts in non-specified, unconventional ways
Responding to direct intra- or extra-team supervisory control	Coordinating actions **CA** The process by which team actions are coordinated	Mutually adjusting roles and activity in response to exigency and the contribution of others

Figure 7.3   Components, attributes and modes of intervening mechanism

While its general utility remained, I judged it preferable to find a perspective that acknowledged interactions between humans, between humans and material resources, and between humans and the environment.

7.4   A model of situated behaviour

The perspective that best suits this is situated action (Suchman, 1987). This perspective was originally developed as a tool for investigating human computer interfaces and to identify and quantify the limitations of computers because of their inability to interact with their environment in a truly sentient and therefore heuristic way. In this process of theoretical development it also provides a logical and theoretically sound extension of the symbolic interactionist perspective, because Suchman's original discipline is sociology and she acknowledges explicit connections between the two (Suchman, 1987).

But the use of situated action as a theoretical model also overcame three criticisms of symbolic interactionism. First, Haralambos (1987) noted that traditional symbolic interactionist models tended to relate to individual events and focus on cognitive properties of the mechanism that connects stimulus and response. This analysis has studied a variety of events in dissimilar domains and revealed both cognitive and non-cognitive properties of the mechanism. Second, Skidmore (1975) criticized symbolic interactionism for largely failing to explain why people respond in a particular way rather than in any of the other ways they might possibly have responded. My explication, by revealing properties of the generative mechanism and connecting these to key behaviour traits allows for an almost infinite spectrum of possibility given the focus on unique aspects as a key influence in configuring responses. Third, and in a similar vein, Meltzer, Petras and Reynolds (1975) criticize the lack of broader environmental influences. I have identified a broad range of attributable influences, located in two components – resourcing and configuring.

As I have already alluded, Suchman (1997) developed her concept of situated action from the symbolic interactionist model to entrain non-cognitive attributes like material resources. Also, rather than eschew the notion of plans and procedures entirely she located them as design exemplars from which effective action can be developed. In her view plans became exemplary resources for situated action, but did not in any strong sense determine its course.

However, Piaget (1979) had already proposed a distinction between action and behaviour. He argued that actions were the consequence of psycho-physiological functions, like raising an arm, while behaviour was intelligently purposive, intended to change the environment or an actors relationship to it, like raising an arm to strike or protect. In the light of the data I elected to invoke Piaget's understanding and develop a model of situated behaviour.

The situated behaviour connection with the apparently discrete elements of stimulus – mechanism – response only became apparent in this study after the two components of the mechanism emerged. The data revealed that all informants conceptualized situation

as the stimulus moderated by the resourcing component and behaviour as the way in which they configured their response and the response as enacted.

This new arrangement, shown in Figure 7.4, had several advantages. First, it aligned with the data to represent the lived experience of the informants, who held a tacit understanding of situated behaviour; second, it integrated cognitive and non-cognitive attributes in a manner that the symbolic interactionist model, even in a fairly loose interpretation would not; third it made explicit the connection between symbolic interactionism and situated behaviour (sic). Importantly it also overcame a criticism of symbolic interactionism, identified by Suchman (1987) and supported by the data, that we cannot credibly abstract mechanism from stimulus or response from mechanism. Indeed, when she initially introduced her concept of situated action she specifically noted that all action depended in essential ways on both material *and* social circumstances and that rather than interpreting action as the output of abstracted rational planning we should instead 'study how people use their circumstances to achieve intelligent action' (Suchman, 1987:50). Thus situated behaviour as theory and practice captured the reported experience of informants that situation begets behaviour that changes the situation, which begets modified behaviour *ad infinitum*.
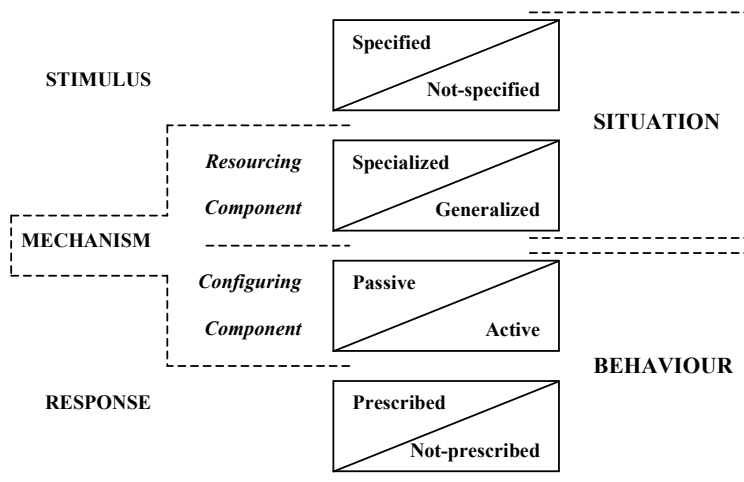
Figure 7.4   Connecting symbolic interactionism with situated behaviour

7.5   Propositions

The elements of the model and the adduced theoretical linkages produced a number of propositions that were not previously well enough developed to locate in the emerging theory. It was not until the model was complete and the relationships between the elements of the model were fully developed that the substance of the propositions became explicable. However, the combination of the preceding summary analysis and the embedded models together with the following explanation provides the rationale for the propositions.

114

As the analysis developed over the three domains I was able to move to a high level of abstraction summarized in two categories of stimulus (specified and not-specified) connected to two categories of response (prescribed and not-prescribed) via two components of the intervening mechanism (resourcing and configuring) each having two modes (specialized and generalized) and (passive and active) respectively. It is the adduced connections between these categories and components that form the basis of the propositions.

So, insofar as the stimuli tend to be specified, the modes of the mechanism in use will tend to be specialized and passive and the responses will tend to be prescribed. It is this state of affairs that corresponds to the Weberian ideal type rather than any realistic representation, average or summary of encountered phenomena. However, this is in itself an interesting theoretical insight, offers a useful methodological tool as background against which the infinite variety of configuring possibilities can be set and, importantly, and using Weber's (1947) notion of objective possibility does not deny the possibility that such an arrangement may be encountered as a phenomenon rather than as a tendency. Indeed, away from the UHiVES context the literature suggests that this is an increasingly prevalent phenomenon, finding ultimate expression in the classical school.

Conversely, insofar as stimuli tend to be not-specified, the modes in use will tend to be generalized and active and the responses will tend to be not-prescribed. Informants in all domains emphasize that while they use the specified/specialized/passive/prescribed arrangement as exemplar, the tendency to not-specified/generalized/active/not-prescribed is normal, immediate and significant, and the opportunities to reverse the tendency are rare.

The propositions that link these insights are listed shown below and the theoretical links are shown in Figure 7.7

Proposition 1a   The more specified the stimuli tend to be the more specialized the resourcing component will tend to be

Proposition 1b   The more not-specified the stimuli tend to be the more generalized the resourcing component will tend to be

Proposition 2a   The more specialized the resourcing component tends to be the more passive the configuring component will tend to be

Proposition 2b   The more generalized the resourcing component tends to be the more active the configuring component will tend to be

Proposition 3a   The more passive the configuring component tends to be the more prescribed the responses will tend to be

Proposition 3b   The more active the configuring component tends to be the more not-prescribed the responses will tend to be
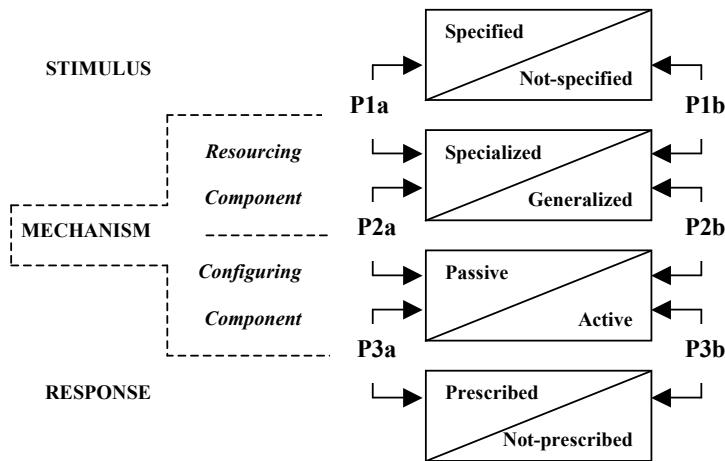
Figure 7.5   Relationship of propositions to theoretical model

7.6   Agile configuration as a discrete type of situated behaviour

What has gone before has progressively incorporated all the data from the study and located it in a model of situated behaviour. However, what is also evident from the data is that a discrete type of situated behaviour that emerged from the data was distinctive in that it was characterized by very rapid initial configuration and subsequent, often numerous, reconfigurations of resources.   Although the concept of situated behaviour captures the important notion that behaviour must be embedded in rather than abstracted from its situation it has little to say about speed *per se*, save that the need for speed may be evident in the situation. Equally, none of the attributes that emerged from the data was specifically related to speed.

However, the best description of the phenomenon was that the dynamic contextual demands of unpredictability, high velocity and error sensitivity required actors in each domain to be agile in their configuring process. Put more plainly, the primary expression of situated behaviour identified in this research is 'agile configuration'. Dictionary definitions of agility are explicit as to 'readiness for motion' coupled with 'actions characterized by quickness, lightness, and ease of movement' born of 'mental alertness and speed of thought' (Chambers, 2005; OED, 1989). On these readings, agility therefore connotes a superior level of fitness and resource together with an innate or learned ability to behave appropriately during rapid, perhaps instantaneous, variations in the environment. Thus a cat is considered agile because of its athleticism coupled with economy and appropriateness of movement, especially when hunting fast moving prey. These broad concepts tie in well with the revealed components of resourcing (being properly prepared) and configuring (being able to respond appropriately) at the heart of the model of situated behaviour (Figure 7.4) and therefore the adduced concept of agile configuration.

The concept of agility in organizations has produced a range of contributions from both academics and practitioners. At its core is the guiding principle that an agile

116

organization is one whose processes are specifically designed to respond effectively to unanticipated change (Meade and Sarkis, 1999) and in that key respect it resonates well with the focus and emergent characteristics of this research.

Towell and Christopher (2002) locate its origins in flexible manufacturing and Nagel and Dove (1991) describe how this flexibility has extended to other business contexts as agility based competition progressively replaces mass production as the norm for global commerce (Goldman *et al* 1995) and as the core requirement for commercial success (Dove 1994). However, adherents note an important difference between flexibility and agility. Dove (1995) suggests that whereas flexibility connotes a planned response to anticipated change, agility connotes an uninhibited response to unanticipated change. In this regard also there is a parallel with this research since flexibility mirrors the adduced link between specified stimulus and prescribed response while agility mirrors the link between not-specified stimulus and not-prescribed response (Figures 7.1 and 7.2)

To help understanding of this relatively new concept, the Agility Forum has suggested four dimensions of activity (Goldman *et al* 1995) articulated as: mastering change and uncertainty, leveraging the impact of people, cooperating to enhance competition and enriching the customer. However, what is evident from these dimensions is that none is timed based nor demonstrably time critical. The extent to which they encourage or deliver agility is therefore unclear. This confusion is exacerbated by the definition offered by Kumar and Motwani (1995) who define agility as the degree of competitive time advantage an organization enjoys over its competitors, which introduce time as the key if not sole determinant without elaboration as to resources and routines.

In what van Hoek *et al* (2001) note is a fairly sparse literature a keynote emerging trend is to focus on agility throughout the supply chain (Christopher and Towell, 2001; Mason Jones *et al*, 2000; Naylor *et al*, 1999; Towill and Christopher, 2002) on the hypothesis that in modern business it is supply chains that compete rather than companies (Christopher, 1992). A subordinate interest within this overall trend is the extent to which the concepts of lean supply and agile supply can be integrated in what are now understood as leagile approaches (Aitken, 2000; Christopher and Towell, 2001, Mason-Jones *et al* 2000). The breadth of intra- and inter-organizational reach that this concept encompasses clearly exceeds the focus of this study however, one outcome of leagile research is the identification and use of a decoupling point (Feitzinger and Lee, 1997) and a concept of postponement (van Hoek, 1998). What this means is that inventory or more generally resources are held in some generic sense (lean) and final assembly or service delivery (agile) are postponed until the decoupling point at which the precise customer requirements are deemed to have become clear.

These insights relate very closely to the processes apparent in my own research domains. In each domain considerable resources, material and intellectual, are held in stock, as it were in docile availability but with no clear idea of what resources will be required. Once specific requirements are clear (patient presentation, aircraft event, fire or other accident) the teams become agile, configuring prepared and improvised resources to satisfy demand until the demand subsides (successful intervention, air traffic control event, extinguished fire) and the organization can become docile again. The conceptual split is evident in the identification of the resourcing component and the

configuring component. That the cycle time is predominantly in minutes does not detract from the basic concept.

Clearly, the links between extant agile enterprise concepts and this research are not universal, not least because of the sweep of the topics that agile enterprise seeks to engage. However, the preceding discussion demonstrates that there are interesting areas of commonality of concept that offer opportunities for contribution.

However, while the model of situated behaviour reveals how actors prepare to respond and then configure their responses in contingently sensitive and therefore appropriate ways it does not specifically satisfy the essential requirement for speed enshrined in the general concept of agility. Yet, evident throughout the data across the domains are continued references to the vital need for speed that is characteristic of the UHiVES context. Further analysis of the data revealed a short list of just four signature routines (Pentland and Feldman, 2002) that nourished this concept of agility, constituted of appropriateness and speed, as a specific expression of the more general concept of situated behaviour.

First amongst these came references to having a superordinate rather than simply an immediate goal, which aligns with Suchman's (1987) concept that situated action (here situated behaviour) is teleological. Although variously expressed in the data these can be summarized as: in A&E this is to sustain life; in ATC this is the safe and expeditious flow of air traffic; in FCR this is to protect people and property. As the informants declared, in extremis it is the focus on these superordinate goals that both drives and warrants autonomous activity, including when this was markedly divergent from any sense of plan or procedure. Thus the first signature routine of agile configuration is identified as - **focus on the superordinate goal**

While in less dynamic contexts doing nothing can be interpreted as behaviour since it may be both teleological and appropriate, the data show that it is a concomitant of the particularly dynamic characteristics of the UHiVES context that action rather than inaction is a primary response. In A&E this included using life-sustaining resuscitation during formal diagnosis. In ATC this included initiating early collision avoidance manoeuvres. In FCR this included using extinguishers and hoses while the situation was still being assessed. The second signature routine emerges as - **bias towards action**

Next, informants repeatedly identified that the unique aspects of situations carry the essential indicators for response. In the A&E domain this included referring a shoulder dislocation from a vehicle accident for elective surgery rather immobilization of the injury because it was a recurring rather than a traumatic injury for that patient. In an ATC example a critical combinations of remaining fuel range and destination weather required a diversion rather than continuing to a planned destination. For FCR the manner in which a fire developed rapidly became dislocated from its initial characteristics. In each of these examples attention to unique rather than routine aspects of the situation focused the resolution. This reveals the third signature routine as - **attend to the unique aspects of the situation**

Finally, while most evidence points to the fact that across the domains the teams are well resourced, both materially and intellectually, it was widely reported that the instantaneous use of available or improvised resources (after De Certeau, 1984) facilitates rapid action. Examples include the use of elastic bands as ligatures and staples as suture in A&E, reversion to the use of flight strips and procedural separation for radar failure in ATC and the use of a decommissioned appliance to augment equipment at a serious fire in FCR. This identifies the fourth signature routine as - **use the resources to hand**

Accordingly, in these domains, and I propose therefore also in other domains that share the contextual characteristics of UHiVES, the distinctive characteristics of the signature routines listed in Figure 7.5 serve to identify agile configuration and represent how, in this context behaviour is situated.

Focus on superordinate goal
Bias towards action
Attend to the unique aspects of the situation
Use the resources to hand

Figure 7.6   Signature routines of agile configuration

Incorporating these signature routines of agile configuration into the theoretical model demonstrates the logical and theoretical links that connect each stage of theory development to produce the integrated model of agile configuration shown in Figure 7.6 .
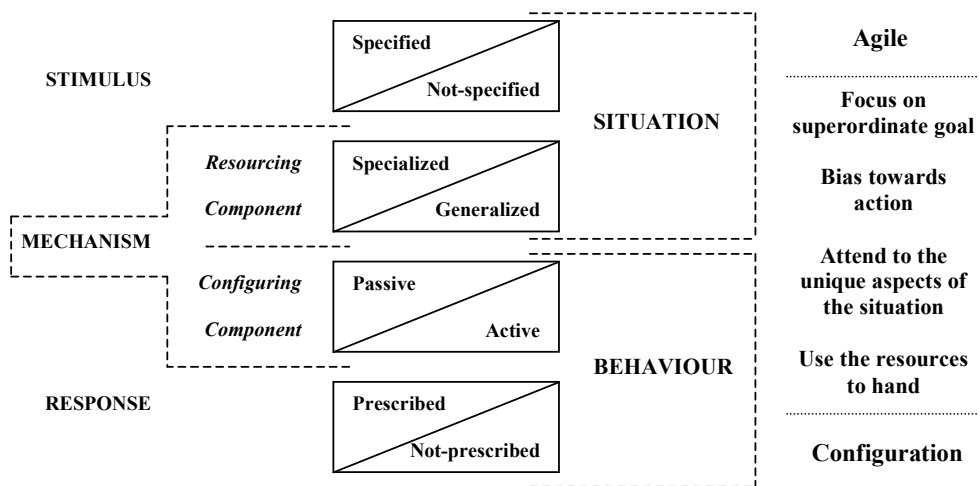
Figure 7.7   An integrated model of agile configuration

7.7   Theoretical statement

Teams working in domains characterised by unpredictability, high velocity and error sensitivity use agile configuration as their primary behaviour. Agile configuration is a discrete type of situated behaviour characterized by four signature routines that can be expressed as:

> Focus on superordinate goal
>
> Bias towards action
>
> Attend to the unique aspects of the situation
>
> Use the resources to hand

7.8   Summary

In this study I determined to explore the phenomenon of response configuration in extreme contingencies. Dissatisfied by more traditional contingency explications my purpose was to discover by what mechanism autonomous responses to unpredictable circumstances were configured. I located the research in the context of extreme contingencies by combining unpredictability with high velocity and error sensitivity and employed a theoretical replication logic across three dissimilar domains using a grounded theory approach within a critical realist ontology.

The findings of this study build along a continuous, logically and theoretically linked trajectory from an initial symbolic interactionist model of stimulus-mechanism-response through a more integrated model of situated behaviour to reveal a specific expression of agile configuration.

The initial symbolic interactionist perspective revealed important and parsimonious typological characteristics of stimulus and response, attributes of the intervening mechanism and two components of the mechanism that grouped the attributes. That these attributes included some that had non-cognitive characteristics suggested that a different model was required that would subsume them. This was identified as situated action (subsequently modified to situated behaviour), a model that readily accommodated all the attributes and facilitated the grouping of stimulus with resourcing component in situation and the grouping of configuring component and response in behaviour.

However, the specific contextual characteristics of unpredictability, high velocity and error sensitivity revealed a particular expression of the more general concept of situated behaviour in an original concept of agile configuration, which had four signature routines. The elements of the model and the adduced theoretical linkages gave rise to six hypotheses linked in three complementary pairs.

CHAPTER 8

CONCLUSIONS

8.1   Contribution

Commenting on the very notion of theory, Barrow (1999) observes that, in common parlance, theory has come to convey the idea that a statement is wildly speculative, uncertain or even hair-brained. However, he emphasizes that scientific theories are cohesive systems of ideas taken as provisional noting that when good theories are superceded they generally turn out not to be wrong rather, they turn out to be limiting expression of a more general description. This resonates with views expressed by Smith (1880) that early versions of any system, from machines to philosophies, are always the most complicated and subsequent version become progressively parsimonious

Accordingly, when a PhD thesis appears to tilt at prestigious windmills, from a relatively low position in the academic food chain, the candidate, the panel, previous theorists and the academy at large can take comfort that the edifice of knowledge is not about to be brought down. In this thesis I have tilted at a number of prestigious windmills, with due humility I hasten to add, and must now account for the manner in which I believe that I have added to the fund of scientific knowledge specifying what I believe to be new as well as what supports other perspectives.

This thesis makes several contributions to knowledge, which are described below. After explaining the original contributions that I claim for the concept and model of agile configuration, I then describe contributory links to extant theories in the sequence in which I introduced key theoretical insights to inform empirical findings. I signify links with relevant paragraphs shown in parenthesis.

8.1.1   Agile organization (7.5)

Primarily, by triangulating data from three dissimilar domains, I have identified an original concept of agile configuration as the primary configuring mechanism in the context of unpredictability, high velocity and error sensitivity, and located this as a discrete expression of an original concept of situated behaviour. This concept is original in that it integrates Suchman's (1987) concept of situated action with Piaget's (1979) concept of behaviour. Although the implications of the change from action to behaviour may appear minimal, this new integration of concepts better reflects the data in which the theoretical development is grounded. In the process the adduced typologies of stimuli and responses coupled with the identified components and attributes of the intervening mechanism and the alignment of these with fundamental characteristics of situated behaviour also makes explicit an original link between the concepts of situated behaviour (after Suchman, 1987 and Piaget, 1979) and symbolic interactionism (Blumer, 1969).

8.1.2   Contingency theoretic perspectives

A key purpose in this research was to provide provocation to and support for the development of new insights in contingency theoretic approaches that would extend mainstream concepts that advocate a necessary close fit between structure and environment for maximum effectiveness (Burns and Stalker, 1961; Woodward, 1965; Lawrence and Lorsch, 1967; Pugh and Hickson, 1976; Donaldson 2001). While those fundamental concepts are not in question here, as traditionally articulated they tend to represent too macro a view (organizational), isolate too few variables (e.g. size, technology, etc.) and produce structures that while contingent given the foregoing constraints are quasi-enduring. None of these provides useful guidance in very dynamic environments (Eisenhardt 1989), but the concept of agile configuration provides guidance in two ways.

First, it moves the conversation from its traditional location in the identification of quasi-enduring contingent structures predicated on a limited range of predicted environmental variables to one that identifies more rapid responses to increasing rates and magnitudes of change across a vaster range of variables. Second, rather than attempting to identify and classify environmental variables and to design suitable organizational structures, agile configuration focuses on the ability to change appropriately and with speed to deal with environmental contingency whatever its particulars. In sum these findings therefore contribute to traditional contingency concepts by explicating configuring process rather than describing contingent structures.

In essence this extends the trajectory of neo-contingency theoretic research beyond the concept of ambidexterity (Duncan, 1976; Gibson and Birkinshaw, 2004) that identifies how different structures operate at different levels (structural ambidexterity) at different times (temporal ambidexterity) or for different purposes (contextual ambidexterity) towards a concept of multidexterity that potentially embraces all three through agile configuration. This also suggests that structural asymmetry (Moon *et al*, 2004) that deals with the difficulties of changing between structures, can be ameliorated with the development of agile configuration techniques that might avoid any structure becoming too dominant for example when lean overrides agility (Christopher and Towill, 2001).

8.1.3   Knowledge   (4.4.2)

The configuring and resourcing components of the intervening mechanism give empirical support to the concepts of deliberative and calculative rationality explicated by Dreyfus and Dreyfus (1984). In turn these are linked to concepts of tacit and explicit knowledge (Polanyi, 1966; Nonaka and Takeuchi, 1995) respectively by showing that the practical infinitude of response options could not be encapsulated either in meaningful archetypal form or by reference to rules and procedures. Rather, following Polanyi (1966) and Dreyfus and Dreyfus (1984) responses are shown as grounded in the informants' tacit knowledge of their fields and their use of deliberative rationality

8.1.4 Situated action (5.5.1)

I combined Piaget's (1979) concept of behaviour with Suchman's (1987) concept of situated action to develop a new concept of situated behaviour. Further, showed how the components and attributes of the mechanism establish new empirical support for Suchman's espoused connection between symbolic interactionism and situated action. The empirical evidence is encapsulated in a theoretical model of situated behaviour that links to the SMR model via the four elements of the intervening mechanism (Figure 5.6)

8.1.5 Coordination (5.5.3)

Unmoderated application of the concepts of coordinating mechanisms (Mintzberg, 1979), grounded as they are in formal divisions of labour, relatively stable organizational structures and planned coordination (Larsson, 1990), proved problematic in these domains. However, the findings revealed that to achieve the essential flexibility necessary in high velocity domains (Eisenhardt, 1979) the mechanisms remained valid, if employed jointly and severally, in contingent rather than rationally designed combinations. Also, because they were found to be manifest across all the components and modes of the intervening mechanism (Figure 5.5) the findings revealed that in these domains they are better conceived of as malleable routines (Nelson and Winter, 1982) rather than as delimited mechanisms (Mintzberg, 1979) of coordination. (see 8.1.4 below)

8.1.6 Routines (5.5.4)

The findings give empirical to support the concepts of ostensive and performative (Pentland and Feldman, 2002) aspects of routines (Nelson and Winter, 1982) locating the ostensive aspect in the resourcing component and the performative aspect in the configuring component of the intervening mechanism as exemplars and sources of behaviour respectively and as coordinators (see 8.1.3 above) that render simultaneous activities mutually consistent (March and Olsen, 1989).

8.1.7 Bricolage and improvization (6.4.1)

The findings add to the concept of bricolage as artisan-like inventiveness (De Certeau, 1984) by revealing that bricolage was evident when resources were both plentiful and lacking. The findings therefore corroborate Cunha's (2005) broader concept of the bricoleur as someone who departs from the event to configure a resolution to the problem by asking - how might this challenge be resolved with these resources? - whatever the resource base is.

Grounded in the context of rapid response to unpredicted events, the model of agile configuration therefore provides a process model for improvisation. A key characteristic of improvization is that composition and performance of any activity coincide in time (Hatch, 1997a) also, improvization is based on preparation (Kernfeld, 1995). The resourcing component helps individuals or teams prepare for improvisation while the configuring model provides a framework for the activity of improvization itself. The signature routines frame behaviours without prescribing specific behaviours, which reflects the essence of improvization.

8.1.7   Dynamic capability   (6.4.2)

Although dynamic capability is traditionally seen as a strategy issue, Ghemawat (2001) suggests that a general dynamic capability might be expressed simply as the ability to renew, augment, and adapt. Zollo and Winter (2002) view dynamic capability as a learned and stable pattern of collective routines through which an organization systematically generates and modifies its operating routines in pursuit of improved effectiveness. Ferdinand *et al* (2005) suggest that dynamic capability focuses on operating routines rather than vague competencies. Eisenhardt and Sull (2001) and Eisenhardt and Martin (2000) identify the need in high velocity environments for these routines to be relatively simple rather than complicated, experiential rather than analytic and iterative rather than linear. None of these descriptions necessarily entails a strategic focus, although they will have strategic implications.

The contribution from this study to dynamic capability is in four parts. First, agile configuration is a model for renewal, augmentation and adaptation (Ghemawat, 2001) albeit at very high velocity. However, the concept of agility embraces the notion of appropriate speed and therefore the model can be used whatever the speed or turbulence of the environment. Second, the model fulfils the requirement of routines for improved effectiveness (Zollo and Winter, 2002) since that is the focus of activity in the research domains. Third, and as a corollary of the second, it focuses on routines rather than competencies (Ferdinand *et al* 2005). Fourth, because it is grounded in high velocity environments it is simple, with only four signature routines, experiential and iterative.

Thus the adduced concept of agile configuration extends the fundamental principles of dynamic capability (Teece *et al*, 1997) precisely because it explains how teams configure endogenous resources in contingent ways to cope with exogenous changes and is applicable whatever the predictability, velocity or error sensitive of the environment. With the trajectory of dynamic capability conversations apparently moving from quasi-enduring strategic competencies towards quasi-strategic operational routines, the model has potentially high utility.

8.2   Some implications for management practice

Throughout the study I held in constant consideration the potential for generalization of the findings beyond theory and beyond the specialized context and domains in which we investigated. Weick et al. (1999) conceptualized high reliability organizations as incubators of adaptive organizational forms in complex environments, which reveal the distinctive processes effective in demanding situations. This leads on from an earlier more general suggestion that similar processes are inherent and observable in all organizations but to varying levels of development (Weick and Roberts 1993). Although high reliability organizations were originally conceptualized as those dealing with catastrophic potential (Weick et al. 1999) it is clear from other literature that high reliability concepts influence developments in a wide range of other contexts, for example: education (Stringfield, 1994); telecommunications (Cox, 1998); pastorialism (Roe *et al*, 1998); medicine and emergency services (Reason 2000).

Accordingly, high reliability influences are increasingly present, to a greater or lesser degree in any organization seeking failure free mission delivery. With rapid

124

autonomous response to contingent aspects of the environment at the core of high reliability thinking (Brown, 1993) the outcomes of this research therefore have the potential to contribute to practice across a range of endeavour. Finally, encouraged by Pettigrew (1974) I believe that by learning from extreme situations I have revealed something of equal value to more benign environments. Accordingly, I propose that the findings and models have general application especially for organizations nurturing similar failure free visions, however turbulent their environment.

Specifically, for managers already experiencing extreme levels of environmental turbulence, especially those working in directly analogous contests and domains, the model, being grounded in just this context, is therefore directly and immediately applicable.

Further, having located my contribution in part in the concept of dynamic capability (Teece *et al*, 1997) I would propose that one potential implication for practice would be to include agile configuration as an alternate or general dynamic capability.

More generally as an aid to managers operating in a variety of contexts and domains, not simply those that are analogous with the context and domains of the study, the elements of the theoretical model provide a resource that can be applied to a variety of needs. These might range from a bottom-up design template for agile configuration via a running audit or review resource for agile organizations to a top-down analytical tool to investigate organizational pathologies related to agility. As has been demonstrated in separate research on knowledge management in innovation projects (Tranfield *et al*, 2003) these kinds of models do not prescribe what actions are required, they simply signpost those areas where action is most relevant and offer examples.

For example, an organization that is facing the challenge of increasing environmental turbulence may wish to adopt a form of agile configuration and can therefore use the components, attributes and modes to make decisions on specific resourcing and configuring developments that will assist them in coping with such turbulence as they encounter. Clearly, this may be simply a relative increase rather than analogous with the absolute and extreme examples in the study. It is important to be clear that agility connotes speed and appropriateness of behaviour in the context of experienced or predicted environmental turbulence and has no absolute criteria. But what is more important than the degree to which the models apply is the notion that they do apply and can be used in any environment where turbulence is a significant factor. Similarly, that the degree to which the models apply can change with changing levels of turbulence without the need for fundamental amendment. Indeed, again invoking Pettigrew (1974), the findings of research revealed in the cauldron of the UHiVES context are more likely to be of universally applicability than those revealed in more benign environments.

Alternatively, the components, attributes and modes can be used as an audit-cum-review resource for organizations already established on an agile trajectory to ensure that their resources and processes remain well-honed and suitably focused.

Finally, the model can be used as a resource for analysis in organizations suffering turbulence related pathologies. However, I would caution here that a simple checklist

approach may not reveal significant underlying problems, unless the theoretical groundings are understood.

From these broad inferences, designers and analysts can refer to the models I have developed to identify what components, attributes and modes, as illuminated by the descriptors in each case, applied in both broad and more detailed terms, might inform what initial design or subsequent remedial interventions are appropriate.

By way of illustration, consider two examples from publicly available data.

In the subway tragedy in Korea of February 2003, the procedures for dealing with a train fire included electrical isolation of the immediate rail system. In this case this led to a train unaffected by the initial conflagration being enveloped because it was marooned on the opposite platform, unable to depart because of the electrical isolation. Using my model, the stimulus the station operator faced was not-specified (two trains) but his response was still prescribed (isolation). This suggests that in his domain the resourcing component was too specialized (e.g. rule and procedure-bound) and/or the configuring component was too passive (e.g. lack of focus on the unique aspects of the situation) and therefore as an individual and as part of a team and organization he lacked the agility to behave in a situated way.

More positively, only a radical approach, necessarily disconnected from prescription, made the recovery of Apollo 13 in April 1970 possible. The not-specified stimulus (massive malfunction) called forth not-prescribed responses (e.g. the improvization of filters and the sling-shot recovery), precisely because the resourcing component was generalized (to deal with the not-specified) and the configuring component was active (through constant improvization validated where possible by simulation).

The results of this study indicate that ever deeper understandings of situations, behaviours and their intimate relationship as exemplified in the agile configuration concept are possible and that these can have a direct impact reliability and avoid catastrophe across a range of contexts and domains.

8.3   Limitations of the study

I acknowledge that this study in common with all research, but perhaps more so at this level of professional development, suffers from a number of limitations.

First, the study was undertaken in a delimited and extreme context and the ability to generalize beyond that context is hindered both by the particulars of the context and by the case study approach. With regard to the particulars of the context I purposely invoked the notion of extreme (Pettigrew, 1974) to take advantage of the learning potential accepted to reside therein. Interpreting extreme as dramatic, spontaneous and intense experience, Pettigrew (1974) proposes that such experience has the highest learning potential. He notes that in dramatic and intense situations, factors such as the signal-noise ratio may mask the available lessons and that the fatigue induced by the situation may limit the learning, which in fact takes place, either contemporaneously with the action or subsequently by reflection. Turning these notions to advantage, here I

propose that, while Pettigrew is speaking of high learning potential for actors, the same argument is also valid for researchers. By analogy, by researching in extreme environments, the value of the research outcomes have high potential but, since the researcher is observing rather than participating in the extreme situation, and subsequently reflecting on possible reasons for observed phenomena, he/she is therefore better placed to penetrate the noise to find the signal, at the same time remaining less prone to the limitations imposed by physical and mental fatigue. In addition, the researcher brings academic skills perhaps not available to actors. Pettigrew also notes that theories developed in this way tend to have a general applicability.

Turning now to the case study approach. Case studies perform an important function in theory building, especially when investigating emergent organizational behaviour where current theory is weak or under-developed and there are potentially many variables (Hartley, 1994). Case studies also allow us to explore social processes in their natural organizational and environmental context, often revealing uniqueness rather than typicality and enable us to engage closely with the informant's domain to capture the concepts and categories used by the informants to organize their world and therefore aid the emergence of new insights (Jones, 1987). Yin (1994) notes that cases studies are also useful when the boundaries between context and phenomena are not clearly evident and context is deliberately part of the design. The limitation on generalizability of the case study outcomes is subsumed by the purpose. In case study the purpose is to produce rich descriptions (Yin, 1994) on which propositions or hypotheses may be based rather than to construct predictive model. However, it remains possible to generalize across domains within context and more tentatively beyond context.

All research suffers from some limitation of resource. Especially in the preparation of a PhD thesis, the limitations of relatively low skill levels and single researcher activity severely restrict the range and amount of data that can be collected and analysed. There is also the fear that, especially when using grounded theory in combination with case study, an additional data set or sets would reveal wholly new and unexpected concepts (Harrison, 2001). Similarly, it is seldom possible to be absolutely rigorous about theoretical sampling (Glaser, 1998). The direction in which this tenet points may not be available and there will always be limitations on access and time. However, in addressing these issues I contented myself that demonstration of good process that stayed as close to the absolute requirements of the grounded approach as possible would allow valuable and original theoretical insights to emerge, albeit part-formed.

In addition, limitations when properly explicated serve two purposes. First, they constrain the sweep of theoretical development achievable by the researcher and expected by the reader and second, they act as a provocation to further research either by the original or other researchers in which the previous limitations can be overcome.

8.4   Opportunities for further research

I believe that the findings of this study offer a number of opportunities for further research that would both embellish the contributions identified here and generate new contributions. It is one of the most seductive characteristics of research that the options

are almost limitless so I shall confine my remarks to those that seem to me to be most contiguous, with one exception.

The agile configuration model, together with its related theoretical foundations, could be tested for integrity in a number of ways. Initially perhaps this could be done in different domains within the same UHiVES context. This would triangulate these outcomes and provide new insights that would be useful in refreshing the core and subsidiary concepts. Equally the model could be tested in a dissimilar context, the extreme being predictable, low velocity and error tolerant (PLoVET). This would provide triangulation on the suggested utility of the model outside the focal context and the practical limits to which the concept of agility as a contextually relevant rather than an absolute variable could be extended.

There does seem to be a connection between the ability of the team members to relate well to each other and the ability to effect agile configuration. Another option might therefore be to consider research in domains that do not espouse the same strong, professional, ethical, organizational and collegial characteristics as were evident here. Since this was naturalistic rather than experimental research I did not attempt to control for this variable. Simply replicating the research in a fragmented organization might produce an interesting outcome.

Taking a more fragmented perspective it might be possible either with more data or in a different context to reveal meaningful and therefore measurable archetypes for stimulus and response or indeed for any of the attributes. This would not be my preferred route because I believe that there is strength in the A : not-A argument in the context of UHiVES and agile configuration. However, such an approach might identify the limits of generalizability of the current concepts.

The propositions could be tested, either jointly or severally, to establish baseline statistical significances across similar and dissimilar contexts, domains, group sizes and perhaps whole organizations. However, I suggest that this would be of most use if in parallel tests of practical significance were also included.

Striking an entirely different theme, during the study it occurred to me that a complexity perspective might be illuminating. I am no expert in the field but I detected some characteristics that might suggest interesting issues around self organization under simple rules and/or dissipative systems. As Harvey and Reed (1994) observe, in social systems, the dissipative perspective acknowledges that order is neither always possible nor always desirable. They propose that rather than asking how order is possible (vide the classical or contingency perspectives) we should investigate the mechanism that produce transformations.

With regard to my own further research, I remain grasped by this theme and trajectory and intend to continue to develop the insights I have revealed thus far into a more comprehensive theoretical position. My intentions are therefore to develop the notion of agile configuration within the dynamic capability canon. In addition, and resources permitting, I would like to pursue the complexity perspective. I have a colleague who has published in this area and I may be able to enrol his support.

This continues a trajectory of research that has been undertaken at Cranfield and has resulted in a number of publications.

8.5 Publications

I include here a summary of my publications record for the period 1999 to 2005 during which time I have been a joint or single author of a number of peer reviewed papers for international conferences and journals. These have largely drawn on the research with which I was engaged while employed as a Research Fellow at Cranfield School of Management as well as introducing some interim contributions from the subject matter of my PhD study (marked with *). In addition I produced a research-based report on the contracting process in a large department of the Ministry of Defence holding Agency status and most recently contributed to an international conference on engaged research since joining the Faculty of Business and Law at University of Lincoln as a Senior Lecturer

The theoretical, practical and methodological links between these publications have all contributed to my development as a researcher. In addition, they do share a high-level context of high reliability both as organizational attribute and organizational behaviour, but demonstrate a bias towards behavioural insights. Although the antecedents of high reliability perspectives reside in high consequence activity employing advanced technologies, the principles adduced from a plethora of research initiatives are finding wider expression. It is this search for broader applicability for apparently highly specialized theoretical and practical insights coupled with an interest in developing new theoretical insights that extend current understandings that are at the core of my continuing research interest.

Journal:

Partington, D. Pellegrinelli, S. Young, M. (2005) 'Attributes and levels of programme management competence: an interpretive study', *International Journal of Project Management 23*

Partington, D. Pellegrinelli, S. Young, M. (2003) 'Who is managing your strategic change programmes?' *Management Focus 20*

Tranfield, D. Young, M. Partington, D. Bessant, J. Sapsed, J. (2003) 'Knowledge Management Routines for Innovation Projects: Developing a Hierarchical Process Model', *International Journal of Innovation Management*

*Young, M. (2003) 'Derogation from procedure in turbulent environments: discretionary action as a collective competence of teams in high reliability organizations', *Working Paper Series Cranfield School of Management*

Sapsed, J. Bessant, J. Partington, D. Tranfield, D. Young, M. (2002) 'Teamworking and knowledge management: a review of converging themes', *International Journal of Management Reviews 4 (1)*

Conference:

Young, M. (2005) 'On the production of knowledge: with an application to the utilization problem', *International Conference on Engaged Research*, University of Lincoln, UK, March

*Young, M. Partington, D. (2004) 'Characteristics of collective discretionary actions in high-velocity error-sensitive situations', *Academy of Management Annual Meeting,* New Orleans, LA

Pellegrinelli, S. Partington, D. Young, M. (2003) 'Understanding and assessing program management competence' *PMI Global Congress,* The Hague

Partington, D. Young, M. Pellegrinelli, S. (2003) 'Understanding program management competence: A phenomenographic study', *Academy of Management Annual Meeting,* Denver

*Young, M. (2002) 'Collective discretionary activity in turbulent environments: A new research agenda', *British Academy of Management Conference,* London

Young, M. (2002) 'Configuring for reliability in Defence Estates: Learning from the introduction of prime contracting,' *British Academy of Management Conference,* London

Partington, D. Young, M. (2002) M. 'Configuring knowledge in practice-grounded research networks: a contemporary example', *Academy of Management Annual Meeting,* Seattle

Partington, D. Tranfield, D. Young, M. Bessant, J. Sapsed, J. (2001) 'Mapping contexts of application: a grounded approach to understanding the key dimensions of organizational environments', *Academy of Management Annual Meeting, Washington*

Partington, D. Tranfield, D. Young, M. Bessant, J. Sapsed, J. (2000) 'Learning between sectors: a collaborative, action based research methodology', *British Academy of Management Conference,* Edinburgh

Sapsed, J. Bessant, J. Partington, D. Tranfield, D. Young, M. (2000) 'From IT to teams: trends in the management of organizational knowledge', *R & D Management Conference,* Manchester

Young, M. Tranfield, D. Partington, D. Bessant, J. Sapsed, J. (2000) 'Rigour, pragmatism and academic leadership in management research' *British Academy of Management Conference, Edinburgh*

Report:

Young, M. (2003) 'Regional Prime Contracting Initiative: Lessons Learned in the Scotland Region', Report for Deputy Chief Executive, Defence Estates, March

REFERENCES

Alberti, G (2004) *Departmental Report 2004*, Department of Health, London

Alexander, B. (2002) *How Great Generals Win*, Norton and Co, New York

Allan, D. (1970) *The Philosophy of Aristotle*, Oxford University Press, London

Ambrosini, V. and Bowman, C. (2001) 'Tacit knowledge: some suggestions for operationalization', *Journal of Management Studies* 38 (6) 811–829

Argyris, C. (1999) 'Tacit knowledge and management', in Sternberg, R. and Horvath, J (eds) *Tacit Knowledge in Professional Practice*, Lawrence Erlbaum Associates, Mahwah, NJ

Baker, R. (1972) *Administrative Theory and Public Administration*, Hutchinson, London

Baldwin, H. (1966) *Battles Lost and Won*, Koneck and Konecky, New York

Bannister, P. Burman, E. Parker, I. Taylor, M and Tyndal, S. (1994) *Qualitative Methods in Psychology: A Research Guide*, Open University Press, Buckingham

Barnard, C. (1938) *The Functions of the Executive*, Harvard University Press, Cambridge, MA

Barnes, J. (1975) *Posterior Analytics*, Clarendon Press, Oxford

Barney, J. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management Studies* 17 (1) 99-120

Barrow, J. (1999) *Impossibility*, Vintage Books, London

Bastien, D and Hostager, T. (1988) 'Jazz as a process of organizational innovation', *Communication Research* 15 (5) 582-602.

Becker, M. (2002) 'Routines: A brief history of the concept', in Ioannides, S and Nielson, K. *Economics and Social Sciences: Complements, Competitors, Accomplices?* Elgar, Cheltenham

Bedeian, A and Zammuto, R. (1991) *Organizations: Theory and Design*, Dryden Press, London

Benger J and Glucksman E (2001) *Accident and Emergency Medicine*, Faculty of Accident and Emergency Medicine, London

Bennis, W. and O'Toole, (2005) 'How business schools lost their way', *Harvard Business Review*, May

Berry, J. and Irvine, S. (1986) 'Bricolage: Savages do it daily' in Sternberg, R and Wagner, R (eds) *Practical Intelligence: Nature and Origins of Competence in the Everyday World*, Cambridge University Press, New York

Bhaskar, R. (1975) *A Realist Theory of Science*, Leeds Books, Leeds

Bhaskar, R. (1979) *The Possibility of Naturalism: A Philosophical Critique of Contemporary Human Sciences*, Harvester, Brighton

Bhaskar, R. (1989) *Reclaiming Reality: A Critical Introduction to Contemporary Philosophy*, Verso, London

Bigley, G. & Roberts, K. (2001) The incident command system: High reliability organizing for complex and volatile environments. *Academy of Management Journal*, 44 (6) 1281-1299

Blaikie, N. (1993) *Approaches to Social Enquiry,* Polity Press, Oxford

Blau, P. (1970) 'A formal theory of differentiation in organizations', *American Sociological Review*, 35 201-218

Blauner, R. (1964) *Alienation and freedom*, University of Chicago Press, Chicago, Ill

Blumer, H. (1969) *Symbolic interactionism*, Prentice Hall, Englewood Cliffs, NJ

Boiral, O. (2002) 'Tacit knowledge and environmental management', *Long Range Planning* 35 291-317

Bowen, K. et al, (1994) *The Perpetual Enterprise Machine*, Oxford University Press, New York

Bowman, C. and Ambrosini, V. (2003) 'How the resource-based and dynamic capability views of the firm inform corporate level strategy' *British Journal of Management*, 14 289-303

Broad, C. D. (1975) *Leibnitz: An Introduction,* Cambridge University Press, Cambridge

Brown, A. (1993), 'High reliability organisations: A review and critique of the work of Todd Laporte's Berkeley Group' *Templeton Management Research Papers* 93/9, Templeton College, Oxford

Brown, S. and Eisenhardt, K. (1997), *Competing on the Edge of Chaos*, Harvard University Press, Harvard

Bryman, A. (1988), *Quantity and Quality in Social Research*, Routledge, London

Bryman, A. and Bell, E. (2003) *Business Research Methods*, Oxford University Press, Oxford

Buchanan, D and Huczynski, A. (1997) *Organizational Behaviour: An Introductory Text*, Prentice Hall, London

Burns, T and Stalker, G. (1961) *The Management of Innovation*, Tavistock, London

Byrne, D. (1998), *Complexity Theory and the Social Sciences*, Routledge, London

Calori, R. (2000), 'Ordinary Theorists in Mixed Industries', *Organization Studies,* 23 (6)

Carpenter, M. and Golden, B. (1997) Perceived managerial discretion: A study of cause and effect. *Strategic Management Journal,* 18 187-206

Casti, J. (2000) *Paradigms Regained*, Abacus, London

Child, J. (1972) 'Organizational structures, environment and performance: the role of strategic choice', *Sociology*, 6 2-22

Chisholm, R. (1989) *The Theory of Knowledge,* Prentice Hall, Englewood Cliffs, NJ

Christopher, M. (1992) *Logistics and Supply Chain Management*, Pitman, London

Christopher, M. and Towell, D. (2001) 'An integrated model fro the design of agile supply chains', *International Journal of Physical Distribution and Logistics Management*, 31 (4) 235-246

Cohen, M. Burkhart, R. Dosi, G. Egidi, M. Marengo, L. Warglien, M. and Winter, S. (1996) 'Routines and other recurring action patterns of organizations: Contemporary research issues' *Industrial and Corporate Change*, **5** (3) 653-98.

Collins HM (2001) 'What is tacit knowledge?' in Schatzki, T. Knorr Cetina, K. and von Savigny, E. (eds) *The Practice Turn in Contemporary Theory*, pp 107–119, Routledge, London.

Cox, R. (1998), *Surety of the Nations Critical Infrastructures,* Sandia National Laboratories, PO Box 5800, Albuquerque

Crossan, F. (2004) 'Research philosophy: towards an understanding', *Nurse Researcher*, 11 (1) 46-55

Crossan, M. and Sorrenti, M. (1997), 'Making Sense of Improvisation', *Advances in Strategic Management*, 14 155-180

Crossan, M. Lane, H. White, R. and Klus, L. (1996) 'The improvising organization: Where planning meets opportunity', *Organizational Dynamics* 24 20-35.

Cunha, M. (2005) 'Bricolage in organizations' *FUENL Working Paper Series*, No 474, Universidad Nova de Lisboa, Faculdada de Economia

Cunha, M. Cunha, J. and Kamoche, K. (1999) 'Organizational improvisation: what, when how and why', *International Journal of Management Reviews* 1 299-341

D'Aveni, R. (1994) *Hypercompetition: Managing the Dynamics of Strategic Manoeuvering*, Free Press, New York

Davis, M. (1971) 'That's interesting! Towards a phenomenology of sociology and a sociology of phenomenology', *Philosophy of Social Science,* 1, 309-344

De Certeau, M. (1984) *The Practice of Everyday Life* University of California Press, Berkeley, CA

De Segur, P. (2002) *Memoirs: Napoleon's Expedition to Russi*a, in Sunnerville, C. (ed) Constable and Robinson, London

Delbridge, R. and Kirkpatrick, I. (1994) 'Theory and practice of participant observation' in Vass, V and Wells, P. (eds) *Principles and Practice in Business and Management Research*, Dartmouth, Aldershot

Dey, I. (1999) *Grounding Grounded Theory: Guidelines for Qualitative Enquiry*, Academic Press, San Diego, CA

Dick, R. (2002) 'Grounded theory: A thumbnail sketch', available at *www.scu.edu.au/schools/gcm/ar/arp/grounded.html*, accessed November 2002

Donaldson, L. (1985) *In defence of organization theory*, Cambridge University Press, Cambridge

Donaldson, L. (1986) 'Size and bureaucracy in east and west: A preliminary meta-analysis', in Clegg, S. Dunphy, D. and Redding, S. (eds) *Enterprise and Management in East Asia*, University of Hong Kong, Hong Kong

Donaldson, L. (1995) *American Anti-management Theories of Organization*, Cambridge University Press, Cambridge

Donaldson, L. (2001) *The Contingency Theory of Organizations*, Sage, Thousand Oaks, CA

Dosi, G. Nelson, R. and Winter, S (2000), 'Introduction: The Nature and Dynamics of Organizational Capabilities' in Dosi, G. Nelson, R. and Winter, S (eds) *The Nature and Dynamics of Organizational Capabilities*, Oxford University Press: Oxford.

Dosi, G. Teece, D. and Winter, S. (1992), 'Toward a theory of corporate coherence: Some preliminary remarks' in Dosi, G. Giannetti, R. and Toninelli, P. (eds) *Technology and Enterprise in a Historical Perspective*, Clarendon Press: Oxford.

Dove, R (1995) 'Measuring agility: the toil of turmoil', *Production*, 107 12-14

Dove, R. (1994) 'The meaning of life and the meaning of agile', *Production*, 106 14-15

Dreyfus, H. and Dreyfus, S. (1984) 'From Socrates to expert systems: the limits and dangers of calculative rationality' *University of California at Berkeley Working Paper*

Duncan, R. (1976) 'The ambidextrous organization: Designing dual structures for innovation' in Kilman, R. Pondy, L. and Slevin, D. (eds) *The Management of Organizations*, North Holland, New York

Durkheim, E. (1982) *The Rules of Sociological Method*, Free Press, New York

Easterby Smith, M. Thorpe, R. and Lowe, A. (2002) *Management Research: An Introduction*, Sage, London

Eisenberg, E. (1990) 'Jamming: Transcendence through organizing', *Communication Research* 17 139-164.

Eisenhardt, K and Sull, D. (2001) 'Strategy as simple rules', *Harvard Business Review* January

Eisenhardt, K. (1989) 'Making Fast Decisions in High Velocity Environments', *Academy of Management Journal*, 32 (3) 543-576

Eisenhardt, K. (1989) 'Making fast strategic decisions in high velocity environments'. *Academy of Management Journal* 32 543-576.

Eisenhardt, K. and Martin J. (2000) 'Dynamic capabilities: What are they?' *Strategic Management Review*, 21 1105-1121

Emery, F. and Trist, E. (1975) *Towards a Social Ecology: Contextual Appreciations of the Future in the Present*, Plenum, London

Emmett, E. 1972. *Learning to philosophize,* Pelican, London

Etzioni, A. (1975) *A Comparative Analysis of Complex Organizations*, Free Press New York

FAEM (2004) *The Way Ahead Report*, Faculty of Accident and Emergency Medicine, London

Fayol, H. (1949), *General and Industrial Management*, Pitman, London

Feigenbaum, E. and McCorduck, P. (1983) *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World*, Addison-Wesley, Reading MA

Feitzinger, E. and Lee, H. (1997) 'Mass customisation at Hewlett Packard – the power of postponement', *Harvard Business Review*, Jan-Feb 116-121

Feldman, M. (2000) 'Organizational routines as a source of continuous change' O*rganization Science* 11(6) 611-629.

Feldman, M. S. and Pentland, B. T. (2003) Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly,* 48(1), 94-118

Finkelstein, S. & Hambrick, D. (1990) 'Top-management team tenure and organizational outcomes: The moderating role of managerial discretion', *Administrative Science Quarterly,* 35 484-503

Follett, M. (1973) *Dynamic Administration: The Collected Papers of Mary Parker Follett*, Pitman, London

Francis, A. (1991) 'The structure of organizations' in Sisson, K (ed) *Personnel Management in Britain*, Blackwell, Oxford

Galbraith, J. (1977) *Organization Design*, Addison-Wesley, Reading, MA

Gardner, H. (1997) *Leading Minds: An Anatomy of Leadership*, Harper Collins, London

Geertz, C. (1973), *The Interpretation of Cultures,* Basic Books, New York.

George, C. (1972) *The History of Management Thought,* Prentice Hall, London

Ghemawat, P. (2001) *Strategy and the Business Landscape*, Prentice Hall, Upper Saddle, NJ

Gibson, C. and Birkinshaw, J. (2004) 'The antecedents, consequences and mediating role of organizational ambidexterity, *Academy of Management Journal*, 47 (2) 209-226

Gill, J. and Johnson, P. (2002) *Research Methods for Managers*, Sage, London

Ginnett, R. (1988) 'Cockpit crew effectiveness from the inside out: a micro analysis leading to a macro consideration', *Proceedings of the Eleventh Psychology in the Department of Defence Symposium*, Colorado Springs, CO

Glaser, B. (1978) *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*, Sociology Press, Mill Valley. CA

Glaser, B. (1992) *Basics of Grounded Theory: Emergence versus Force*, Sociology Press, Mill Valley, CA

Glaser, B. (1998) *Doing Grounded Theory: Issues and Discussions*, Sociology Press, Mill Valley, CA

Glaser, B. (2001) *The Grounded Theory Perspective 1: Conceptualization Contrasted with Description*, Sociology Press, Mill Valley, CA

Glaser, B. (2002) 'Constructivist Grounded Theory?', *Qualitative Social Research* 3 (3) 1-10

Glaser, B. (2005) *The Grounded Theory Perspective 111: Theoretical Coding*, Sociology Press, Mill Valley, CA

Glaser, B. and Strauss, A. (1967) *The Discovery of Grounded Theory,* Aldine, Chicago

Goffman, E. (1961) *Asylums,* Doubleday, New York

Goldman, S. Nagel, R. and Preiss, K (1995) *Agile Competitors and Virtual Organizations*, Van Nostrand Rheinhold, New York

Gordon, J. (1992) 'Work teams: How far have they come', *Training*, 29 59-65

Gouldner, A. (1954) *Patterns of Industrial Bureaucracy*, Free Press, New York

Gouldner, A. (1970) *The Coming Crisis of Western Sociology*, Heinemann, London

Grabowski, M. and Roberts, K. (2000), 'Risk mitigation in virtual organizations', *Organization Science*, 10 704-721

Graham, P. (1987) *Dynamic Managing – the Follett Way*, Professional Publishing, London

Grant, R. (1996), 'Toward a knowledge-based theory of the firm', *Strategic Management Journal,* 17 109-122.

Guba, E. and Lincoln, Y. (1982) 'Epistemological and methodological bases of naturalistic enquiry', *Education Communication and Technology*, 30 (4) 236–239

Guba, E. and Lincoln, Y. (1988) 'Do inquiry paradigms imply inquiry methodologies?', in Fetterman, D. (ed) *QualitativeApproaches toEvaluation in Education*, Praeger Publishers, New York, NY

Guba, E. and Lincoln, Y. (1994) *Fourth Generation Evaluation*, Sage, London

Hambrick, D. & Finkelstein, S. (1987) 'Managerial discretion', *Research in Organizational Behaviour,* 9 369-406

Handy, C. (1985), *Understanding Organizations*, Penguin Books, London

Hanna, D. (1988) *Designing Organizations for High Performance*, Addison-Wesley, Reading, MA

Hart, C. (2001) *Doing a Literature Search*, Sage, London

Hartley, J. (1994), 'Case studies in organizational research', in Cassell, C. and Symon, G. (eds) *Qualitative Methods in Organizational Research*, Sage, London.

Harvey, D. and Reed, M. (1994) 'The evolution of dissipative social systems', *Journal of Social and Evolutionary Systems* 17 (4) 371-411

Hatch, M. (1997a) 'Jazzing up the theory of organizational improvisation', *Advances in Strategic Management* 14 181-191, JAI Press, Greenwich, CT

Hatch, M-J. (1997b) *Organization Theory*, Oxford University Press, Oxford

Hawking, S. (2002) *On the Shoulders of Giants*, Running Press, Philadelphia, PA

Hospers, J. (1997) *An Introduction to Philosophical Analysis*, Routledge, London

Hough, R. (2001) *Naval Battles of the Twentieth Century*, The Overlook Press, Woodstock

Hussey, J. and Hussey, R. (1997) *Business Research: A Practical Guide for Undergraduate and Postgraduate Students*, Macmillan Business, Basingstoke

Hutchins, E. (1991) 'The social organization of distributed cognition', *Perspectives on Socially Shared Cognition*, 283-307

Hutchins, E. (2000) *Cognition in the Wild*, MIT Press, Cambridge, Mass

Ilgen, D. and Klein, H. (1988) 'Organizational behaviour, *Annual Review of Psychology*, 40 327-351

Johannessen, J-A. Olaisen, J. and Olsen, B. (2001) 'Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it.' *International Journal of Information* Management, 21, 3–20

Johnson, P, and Duberley, J. (2000) *Understanding Management Research: An Introduction to Epistemology*, Sage, London

Johnson, P. and Harris, D. (2002) 'Qualitative and quantitative issues in research design', in Partington, D. (ed) *Essential Skills for Management Research*, Sage, London

Jones, S. (1985) 'The analysis of depth interviews' in Walker, R. (ed) *Applied Qualitative Research*, Gower, Aldershot

Jones, S. (1987) 'Choosing action research', in Mangham, I (ed) *Organization Analysis and Development*, Wiley, Chichester

Journe, B. (2001) 'Sense making and high reliability organizations', Paper presented to *EGOS Colloquium*

Kamoche, K., and Cunha, M. (2001) 'Minimal structures: From jazz improvisation to product innovation', *Organization Studies* 22 (5) 733-764

Katzenbach, J. and Smith, D. (1993) 'The discipline of teams', *Harvard Business Review*, 71 (2) 111-118

Kemmis, S. (1980) 'The imagination of the case and the invention of the study', in Simons, H. (ed) *Towards a Science of the Singular*, CARE, Norwich

Kernfeld, B. (1995) *What to listen for in jazz*, Yale University Press, New Haven

Koestler, A. (1967) *The Ghost in the Machine*, Hutchinson, London

Kolb, D. Rubin, I. and McIntyre, J. (1997) *Organizational Psychology: An Experiential Approach*, Prentice-Hall, London

Kosko, B. (1994) *Fuzzy Thinking*, Flamingo, London

Kumar, A. and Motwani, J. (1995) A methodology for assessing time-based competitive advantage of manufacturing firms, *International Journal of Operations and Production Management*, 15 (2) 36-53

Laporte, T. and Consolini, P. (1991) 'Working in practice but not in theory', *Journal of Public Administration and Theory,* 1 (1) 19-47

Larsson, R (1990) *Coordination of Action in Mergers and Acquisitions: Interpretive and Systems Approaches towards Synergy*, Lund University Press, Sweden

Law, J. and Lodge, P (1984) *Science for Social Scientists*, Macmillan, London

Lawrence, P and Lorsch, J. (1967) *Organization and Environment*, Addison-Wesley, Boston, MA

Lawson, H. (2002) *Closure: A Story of Everything*, Routledge, London

Lazaric, N. (2000) 'The role of routines, rules and habits in collective learning: Some epistemological and ontological considerations, *European Journal of Economic and Social Systems*, **14** (2) 157-71.

Legge, K. (1978) *Power, Innovation And Problem Solving In Management*, McGraw-Hill, London

Levi-Strauss, C. (1966) *The Savage Mind*, University of Chicago Press, Chicago, Ill

Lipman-Bluman, J. and Leavitt, J. (1999) *Hot Groups*, Oxford University Press, London

Locke, K (2001) *Grounded Theory in Management Research*, Sage, London

Losee, J (1993) *A Historical Introduction to the Philosophy of Science*, Oxford University Press, Oxford

Lovell, J. and Kluger, J. (1995) *Apollo XIII*, Simon and Schuster, New York

MacLean, N. (1992) *Young Men and Fire*, University of Chicago Press, Chicago, IL

March, J. and Olsen, J. (1989), *Rediscovering Institutions - The Organizational Basis of Politics*. The Free Press: New York.

Marchington, M. (2000) 'Teamworking and employee involvement: terminology, evaluation and context', in Procter, S. and Muller, F. (eds) *Teamworking*, Macmillan Business, London

Marx, K. (1975) *Early Writings*, Penguin, Harmondsworth

Mason-Jones, R. Naylor, J. and Towill, D. (2000) 'Lean, agile or leagile. Matching your supply chain to the marketplace', *International Journal of Production Research*, 38 (17) 4061-4070

Mead, G. (1934) *Mind, Self and Society*, University of Chicago Press, Chicago, IL

Meade, L. and Sarkis, J. (1999) 'Analyzing organizational project alternatives for agile manufacturing processes: An analytical network approach', *International Journal of Production Research* 37 (2) 241-261

Melin, U. and Axelsson, K. (2005)'Understanding organizational coordination and information systems: Mintzberg's coordination mechanisms revisited and evaluated', in Bartman, D (ed) *Proceedings of the 13th European Conference on Information Systems*, Regensburg, Germany, May

Miles, R. and Snow, C. (1978) *Organizational Strategy, Structure and Process*, McGraw-Hill, New York

Mintzberg, H. (1979) *The Structuring of Organizations*, Prentice-Hall, London

Mintzberg, H. (1983) *Structure in Fives: Designing Effective Organizations* Prentice Hall, New Jersey

Mintzberg, H. (1989) *Mintzberg on Management*, Free Press, London

Mintzberg, H. Raisinghani, D. & Theoret, A. (1976) 'The structure of unstructured decision processes', *Administrative Science Quarterly,* 21 246-275.

Mirvis, P. (1998), 'Practice improvisation', *Organization Science*, 9 (5)

Moon, H. Hollenbeck, J. Humphrey, S. Ilgen, D. West, B. Ellis, A. and Porter, C. (2004) 'Asymmetric adaptability: Dynamic team structures as one way streets', *Academy of Management Journal*, 47 (5) 681-696

Moorman, C. & Miner, A. (1998) 'Organizational improvisation and organizational memory', *Academy of Management Review,* 23 698-723

Moorman, C. and Miner, A. (1995) 'Walking the tightrope: Improvisation and information use in new product development', *Report No. 95-101*, Marketing Science Institute, Cambridge MA

Morgan, G (1997), *Images of Organization*, Sage, Thousand Oaks, CA

Morosini, P. (2000) 'Open Company Values: Transforming Information into knowledge-Based Advantages' in D Marchand (ed) *Competing with Information* Wiley, Chichester

Myers, M. (2000) Qualitative research and the generalizability question: Standing firm with Proteus, *The Qualitative Report*, 4 (3)

Nadler, D. and Tushman, M. (1997) *Competing by Design*, Oxford University Press, Oxford

Nagel, R. and Dove, R. (1991) *21st Century Manufacturing Enterprise Strategy*, Lehigh University, Iacocca Institute

Naylor, J. Naim, M. and Berry, D. (1999) 'Leagility: Interfacing the lean and agile manufacturing paradigm in the total supply chain', *International Journal of Production Economics*, 62 107-118

Nelson, R. and Winter, S. (1982), *An Evolutionary Theory of Economic Change*. Belknap Press/Harvard University Press: Cambridge, MA

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company,* Oxford University Press, New York

Nordhaug, O. (1993) *Human Capital in Organizations: Competence, Training and Learning*, Scandinavian University Press, Oslo

Nozick R. (1981) 'Why is there something rather than nothing?' *Philosophical Explanations* Oxford University Press Oxford

Oliver, D and Roos, J. (2005) 'Decision making in high velocity environments: The importance of guiding principles', *Organization Studies*, 26 (6) 889-913

Oliver, D. and Roos, J. (2003) 'Dealing with the unexpected: Critical incidents in the LEGO mind storms team, *Human Relations*, 56 (9) 1057-1082

Pan, S. and Scarborough, H. (1999) 'Knowledge management in practice: An exploratory case study of Buckman Labs', *Technology Analysis and Strategic Management*, 11 (3) 359-374

Parkhe, A. (1993) 'Messy research, methodological predispositions and theory development in international joint ventures, *Academy of Management Review* 18 (2) 227-268

Partington, D. (2000a) 'Building grounded theories of management action', *British Journal of Management,* 11 (2) 91-102

Partington, D. (2000b) *Research strategies overview*, Lecture notes for the Research Methods Course, Cranfield School of Management

Partington, D. (2001) 'Grounded theory' in Partington, D. (ed) *Essential skills for Management Research*, Sage, London

Pawson, R and Tilley, N. (1997) *Realistic Evaluation*, Sage, London

Penrose, E. (1959) *The Theory of the Growth of the Firm*, Wiley, New York

Penrose, R. (2004) *The Road to Reality*, Jonathon Cape, London

Pentland, B. and Feldman, M. (2002) 'Organizational routines as a unit of analysis' Paper prepared for *Empirical research on routines in business and economics: Towards a research program.* A conference held at Odense, Denmark, November

Pentland, B. and Reuter, H. (1994) 'Organizational routines as grammars of action', *Administrative Science Quarterly*, 39 (3) 484-510.

Perry, L. (1991) 'Strategic improvising: How to formulate and implement competitive strategies in concert', *Organizational Dynamics* Spring 51-64.

Pettigrew, A. (1974) 'Learning in extreme situations' *Warwick Working Papers*, Warwick University

Pettigrew, A. (1995) Distinguished scholar address to the Organization and Management Theory Division of the Academy of Management, Vancouver, August

Piaget, J. (1979). *Behaviour and evolution*, trans. Nicholson-Smith, D., Routledge & Kegan Paul, London

Piantanida, M. Tananis, C. and Grubs, R. (2002) 'Claiming grounded theory for practice-based research: A think piece', *Paper delivered at 2002 Conference on Interdisciplinary Qualitative Studies*, Athens, Georgia

Plotkin, H. (1995) *Darwin Machines and the Nature of Knowledge*, Penguin, London

Polanyi, M. (1966) *The Tacit Dimension,* Routledge & Kegan Paul Ltd, London.

Pugh, D. and Hickson, D. (1976) *Organizational Structure in its Context: The Aston Programme*, Gower, London

Reason, J. (2000) 'Human error: Models and management' *British Medical Journal,* 7 (2) 768 -770

Reed, M. (1991) 'Scripting scenarios for a new a new organization theory and practice', *Work, Employment and Society*, 5 (1) 119-132

Rittel, H. and Webber, M. (1973) 'Dilemmas in a general theory of planning', *Policy Sciences,* 4 155-169

Roe, E. Hintzinger, L. and Labnow, K. (1998) 'High reliability pastorialism', *University of California at Berkeley,* Discussion Paper 3

Rumelt, R. (1995), 'Inertia and Transformation' Pp. 101-132 in Montgomery, C. *Resource-based and Evolutionary Theories of the Firm - Towards a Synthesis*, Kluwer, Dordrecht.

Ryle, G. (1949) *The Concept of Mind***,** Hutchinson, London

Ryle, G. (1979) *On Thinking,* Blackwell, London

Saunders, M. Lewis, P. and Thornhill, A (2003) *Research Methods for Business Students*, FT-Prentice Hall, London

Sayles, C. (1958) *Behaviour of Industrial Work Groups*, Wiley, New York

Schon, D. (1983) *The Reflective Practitioner, How Professionals Think in Action*, Temple Smith, London

Scott, W. (1992) *Organizations: Rational, Natural and Open Systems*, Prentice-Hall, Englewood Cliffs, NJ

Simon, H. (1957) *Models of Man,* Wiley, New York

Simon, H. (1997), *Administrative Behaviour*. The Free Press: New York.

Singh, V. and Dickson, J. (2001) 'Ethnographic approaches to the study of organizations', in Partington, D. (ed) *Essential Skills for Management Research*, Sage, London

Skidmore, W. (1975) *Theoretical Thinking in Sociology,* Cambridge University Press, Cambridge

Skinner, B. (1965) *Science and Human Behaviour*, Free Press, New York

Skinner, B. (1976) *About Behaviourism*, Random House, New York

Smith, A. (1880) *The Wealth of Nations*, Clarendon Press, Oxford

Snape, D. and Spencer, L. (2003) 'The foundations of qualitative research' in Ritchie, J. and Lewis, J (eds) *Qualitative Research Practice*, Sage, London

Stern, P. (1980) 'Grounded theory methodology: Its uses and processes' *Image* 12 (1) reproduced in Glaser, B. (1994) (ed) *More Grounded Theory Methodology: A Reader*, Sociology Press, Mill Valley, CA

Stewart, R. (1983) *Choices for the Manager*, McGraw-Hill, New York.

Strauss, A and Corbin, J. (1997) *Grounded Theory in Practice*, Sage, Thousand Oaks, CA

Strauss, A. and Corbin, J (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Sage, Beverley Hills, CA

Stringfield, S. (1994) 'Towards schools as high reliability organizations. Education reforms and students at risk: A review of the current state of the art', *Working Paper*

Suchman, L. (1987) *Plans and Situated Actions: the Problem of Human Machine Interaction*, Cambridge University Press, Cambridge

Taylor, F. (1947) *Scientific Management*, Harper and Row, London

Teece, D. Pisano, G. and Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal*, 18 (7) 509-533

Torff, B. (1999) 'Tacit knowledge in teaching: folk pedagogy and teacher education', in Sternberg, R. and Horvath, J. (eds) *Tacit Knowledge in Professional Practice* Lawrence Erlbaum Associates, Mahwah, NJ

Towell, D. and Christopher, M (2002) 'The supply chin strategy conundrum: To be lean or agile or to be lean and agile', *International Journal of Logistics: Research and Applications* 5 (3) 299-309

Tranfield, D and Starkey, K. (1998) 'The nature, social organization and promotion of management research: Towards policy', *British Journal of Management*, 9 341-353

Tranfield, D. Duberely, J. Smith, S. Musson, G and Foster, M (2000) 'Organizational learning – it's just routine', *Management Decision,* 38 (4)

Tranfield, D. Parry, I. Wilson, S. and Foster, M. (1998) 'Teamworked organizational engineering: Getting the most out of teamworking', *Management Decision,* 36 (6) 375-385

Tranfield, D. Young, M. Partington, D. Bessant, J. and Sapsed, J. (2003) 'Knowledge management routines for innovation projects: Developing an hierarchical process model', *International Journal of Innovation Management*, 7 (1) 27-49

Tsoukas, H. (2003) 'Do we really understand tacit knowledge?' in Easterby-Smith M and Lyles, M. (eds) *The Blackwell Handbook of Organizational Learning and Knowledge Management,* 410–427, Blackwell Publishing Ltd, Oxford.

Turing, A. (1936) 'On Computable Numbers, with an Application to the Entscheidungsproblem', *Proceedings of the London Mathematical Society*, 42 230-65

Turner, B. (1978) *Man-made disaster*, Wykeham, London

Umpleby, S. (2002) 'Should knowledge of management be organized as theories or as methods?' *www.gwu.edu/~umpleby/recent.html* accessed January 2003

Urwick, L. (1947) *The Elements of Administration*, Pitman, London

Van Aken, J. (2001) 'Mode 2 knowledge production in the field of management'. *Eindhoven Centre for Innovation Studies, Working Paper 01.13*

van Hoek, R. (1998) ' Reconfiguring the supply chain to implement postponed manufacturing', *International Journal of Logistics Management*, 9 (1) 95-110

van Hoek, R. Harrison, H and Christopher, M. (2001) 'Measuring agile capabilities in the supply chain' *International Journal of Operations and Production Management*, 21 (1/2 126126-135

Von Lubitz, D. Carrasco, B. Levine, H. and Richir, S. (2004) 'Medical readiness in the context of operations other than war: development of first responder readiness', *Emispher*

Von Manstein, E. (1958) *Lost Victories*, Henry Reenery, Chicago

Wagner, R. Sujan, J. Sujan, M. Rashotte, A. and Sternberg, R. (1999) Tacit knowledge in sales' in Sternberg, R. and Horvath, J. (eds) *Tacit Knowledge in Professional Practice* Lawrence Erlbaum Associates, Mahwah, NJ.

Walker, C. and Guest, R. (1952) *Man on the Assembly Line*, Harvard University Press, Cambridge, Mass

Wallace, W. (1983) *Principles of Scientific Sociology* Aldine New York

Weber, K. (1947) *The Theory of Social and Economic Organization,* Oxford University Press, Oxford

Weick, K and Roberts, K. (1993) 'Collective mind in organizations: Heedful interrelating on flight decks', *Administrative Science Quarterly*, 38 357-381

Weick, K. (1979) *The Social Psychology of Organizing*, Addison Wesley, Reading, MA

Weick, K. Sutcliffe, K. and Obstfeld, D (1999) 'Organizing for high reliability: Processes of collective mindfulness', in Staw, B. and Sutton, R. (eds) *Research in Organizational Behaviour,* 23 81-23

Wernerfelt, B. (1984) 'A resource-based view of the firm', *Strategic Management Journal,* 5 (2) 171-180

Wheen, F. (1995) 'On dancing elephants, boiled frogs and management gurus', *Life*, 22 January

Whetten, D. (1989) 'What constitutes a theoretical contribution?' *Academy of Management Review*, 14 (4) 490-495

Whetten, D. (2000) 'Developing good theory', *Research Seminar Notes*, Cranfield School of Management

Wilcox-King, A. and Ranft, A. (2001) 'Capturing knowledge and knowing through improvization: what managers can learn from the thoracic surgery board certification process', *Journal of Management*, 27 (3) 255-265

Williamson, O. (1979), 'Transaction cost economics: The governance of contractual relations', *Journal of Law and Economics*, 22

Wilson, O. (1998) *Consilience*, Abacus, London

Wilson, T. (1999) 'Structure in research methods' *Lecture Notes for Department of Information Studies*, Sheffield University (unpublished)

Winter, S. (1964) 'Economics, natural selection and the theory of the firm, *Yale Economic Essays*, 4 225-272

Woodward, J. (1965) *Industrial Organization: Theory and Practice*, Oxford University Press, London

Wright, P. (2000) *Tank*, Penguin Books, New York

Yin, R. (1994) *Case Study Research; Design and Methods,* Sage, London

Zollo, M. and Winter, S. 'Deliberate learning and the evolution of dynamic capabilities', *Organization Science* 13 339-351