Enabling knowledge processes in innovative environments

Sara Pavesi

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ENABLING KNOWLEDGE PROCESSES IN INNOVATIVE ENVIRONMENTS

ICT AS A TRIGGER FOR CHANGES IN KNOWLEDGE MANAGEMENT

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ICT AS A TRIGGER FOR CHANGES IN KNOWLEDGE MANAGEMENT

PROEFSCHRIFT

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PREFACE AND ACKNOWLEDGEMENTS

Getting my PhD was not an easy job, but it was a really exciting and significant challenge.

It all started in 1998 during the great experience of the CIMA project. After I got my Master degree at Politecnico di Milano, I continued to work on research activities at the business school (MIP). There, I had the chance to join the research consortium: Italy, Nederlands, UK, Ireland, Sweden and Australia collaborating in the area of Learning and Continuous Improvement. It was a really important challenge for me: from the working life point of view, it was the first experience in a project, which was really complex from the content and managerial perspectives. But especially from the personal point of view: working in an international context was a real opportunity for sharing and comparing different ideas and cultures.

It all started from CIMA: the PhD was designed in order to continue and strengthen the research collaboration between Milan and Twente. Beyond the enthusiasm, four years are a long time and the working situation changed a lot over time. A partial reorganisation of MIP in Milan in 2000 required many efforts for the development of new training programs. Moreover, the team collaborating in Milan and Twente changed: my initial supervisor resigned and moved to another country.

At the same time new opportunities emerged: the companies involved in the study were very committed in the collaboration with the research group to develop new projects related to the topic. Moreover MIP is considering the possibility to develop new research projects on the topic of the PhD and creating a new centre of competence within the business school. Finally the CInet network consolidated the practice of the international PhD network.

From this experience, I have learned a lot: first of all about knowledge management. I am very happy for the opportunity to study a so relevant but at the same time critical topic. As a managerial engineer, I addressed most of research topics with a double approach: the interest in technology, which is the background of Politecnico di Milano, but also with an interest in management and organisation. I felt very confident with the topic of Knowledge Management, which embeds both the issues. Moreover, during my job at MIP I usually have good opportunities to discuss with companies about new trends, problems and emerging issues and in particular about KM. Companies are nowadays approaching KM through all the technical solutions that their consultants use to suggest. However, the topic is still not clear, and especially it is not clear what is behind all those technical solutions. Companies are looking at the Universities as impartial supporters to approach this issue. At the same time knowledge management is also critical from the academic point of view: many streams of literature, many directions of research, but a general lack of "systemic view" of the issue. During the PhD, I had the opportunity to start to make order on the topic, analysing it from the academic and practical perspectives.

Secondly I learned from the approach. The methodology adopted in the PhD was important for my interests. When I started my PhD I was really interested in "understanding companies". That means to understand the language, interact with them, and understanding phenomena in order to develop frameworks. The goals and methodology adopted in the PhD emphasised this interaction with companies, requiring in some stages to be part of their teams.

Finally, I learned a lot about the team spirit: I got a great support from my colleagues and friends in Twente and in Milan. I learned that trust and team spirit are the key ingredients for successful projects.

So I would like to thank all the people who trusted me in this adventure, especially those who motivated me to continue in difficult moments. First of all, my parents who have always supported me and shared with me the troubles and worries. I want to give special thanks to my grandmother who has organised her first flight for my PhD defence. Then, my brothers Valerio and Vittorio and my sister Erica who made me laughing against the difficulties.

Thanks a lot to my supervisors Olaf and Emilio, who supported me in the complexity of the process of the PhD, and to Mariano without whom I would have never reached the goal. I would never forget the great contribution of all the Kuilder family for the support in writing the thesis, in discussing about life, confronting cultures and learning Dutch (especially thanks to Timo and Jotte!).

I would like to thank also all the CInet group and especially Harry Boer, who contributed so much to the thesis and to Jeannette, always helping me with the procedures of the University.

Then, I thank all the MIP staff and especially the three colleagues sharing the office with me, who supported me whenever I received a feedback from my supervisors.

At last, I would like to thank Stefano a lot for all the encouragement in these years, every time I fell in panic and every time I needed someone to share my joy with.

Finally, I really want to dedicate this thesis to my grandfather Antonio: for all the support and comprehension he gave to me. I wished to share with him also the final step of this challenging experience.

Sara Pavesi

May 2003

CONTENTS

CHAPTER ONE:
PROBLEM DEFINITION AND PURPOSE OF THE STUDY

1.1 INTRODUCTION

"In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge" (Nonaka, 1993, p.96).

"To be a leader in global manufacturing in the 1990s, a company must excel in two seemingly contradictory ways. First it must constantly build and refresh its individual areas of expertise so it has the critical capabilities needed to stay ahead of the pack. And second, it must get its mix of disciplines to work in the ever changing way needed to prevail in the ever changing competitive advantage" (Leonard-Barton et al., 1994, p.121).

The concept of organisational knowledge, as a valuable strategic asset, has become quite popular recently. Organisations are being advised by management theorists that, in order to remain competitive, they must efficiently and effectively create, capture, harvest, share and apply organisational knowledge and expertise. The terms "brainpower" and "intellectual capital" are becoming ever more popular but, at the same time, few managers "grasp the true nature of the knowledge-creating company as they misunderstand what knowledge is and what companies must do to exploit it" (Nonaka, 1993, p.96).

Several issues make the concepts of knowledge and knowledge management extremely challenging and difficult to analyse. First of all, knowledge always begins with an individual (Kim, 1993) and it is not a corporate resource. However, personal knowledge can be transformed into organisational knowledge valuable to the company as a whole (Nonaka, 1993). The purpose of knowledge management is to enhance a firm's performance by designing, implementing, maintaining and improving a system that supports the organisation's knowledge processes (Davenport et al. 1998). Making personal knowledge available at the company level is the real challenge of knowledge-creating companies that have to deal with the issue of tacit knowledge (Polany, 1966). This exists in mental models, beliefs and perspectives; so ingrained that they are taken for granted and cannot be easily articulated (Nonaka and Takeuchi, 1995).
Moreover, knowledge and learning go hand in hand. Defending and enhancing a given knowledge position is most effectively accomplished by continuous organisational learning. The ability of an organisation to learn, accumulate knowledge from its experiences, and reapply that knowledge is, in itself, a skill that can provide competitive advantage (Zack, 1999). The question that arises concerns the relationship between learning and accumulated knowledge and innovation. Companies have, today, to confront themselves with a number of "intertwined changes in their environments" (Boer, 1990) which require the ability to innovate their processes and products but, at the same time, achieve results in terms of efficiency, quality and flexibility. How can accumulated knowledge therefore contribute to manage these changes efficiently and effectively?

The question becomes much more critical when seeing the traditional issue of learning as the repetition of tasks (Boston Consulting Group, 1968; Abernathy and Wayne, 1974): if repetition of tasks (and therefore learning) improves company performances, how can learning take place and be exploited in innovative environments where there is much less repetition of tasks?

Finally, in the past, knowledge has been treated somewhat like air: it is ubiquitous, invisible, taken for granted and never explicitly valued or managed. However, in today's business, firms must explicitly address a range of decisions regarding the creation, development, and maintenance of their knowledge resources and capabilities. The problem is that very little theory has addressed the issue, and moreover there is yet little solid guidance for the practicing manager. The relevance of knowledge is widely recognised (Wernerfelt, 1984; Leonard-Barton et al., 1994; Collis and Montgomery, 1995; Wijnhoven, 1999); but how it can be managed remains an unexplored issue. Recently, however, a growing number of contributions have addressed the processes and infrastructures for sharing and codifying knowledge, especially using new forms of "Information and Communication Technologies" (ICT). These efforts are extremely challenging, but at the same time they have merely addressed the technical applications of ICT (Conklin J. (a), 1996; Bradshaw et al., 1997; Croasdell, 1997), ignoring their impact on the overall organisation.

This thesis considers *how knowledge processes can be supported in innovative and knowledge intensive environments, with particular emphasis on the role of ICT*. The research especially focuses on managerial activities and decisions that help companies in stimulating knowledge processes; on how those decisions are related, with specific focus on ICT; and how they relate with the innovation strategy of the companies.
The research arrives at a set of propositions on sets of managerial activities and decisions: how these decisions are related to each other, what are the expected results according to the innovation strategies of the company, how they contribute to developing new innovation strategies. Two remarks have to be made right at the start: choices concerning ICT in this research are not considered to be the only decisions; they have to be related to all the other managerial decisions for stimulating knowledge processes. ICT will result in a trigger, but is not the only enabler. Secondly the relationship among decisions will be investigated by exploring change: triggered by ICT, the changes in the other decisions, performances and innovation strategies will be investigated and explained.

This thesis stems from a collaboration between the University of Twente and Politecnico di Milano, which have been involved (and still are) in joint EU-funded research projects about topics of common research interest such as organisational learning, knowledge management, and product innovation management. In particular, my collaboration with the team at University of Twente started with the experience of the CIMA project, which is also a very important input for this thesis.

The main goal of this chapter is to introduce the topic, the motivations behind the research, and the research questions, in order to explain the structure of the work and how it is related with the other research work in the University of Twente and Politecnico di Milano. Section 1.2 explains the motivations and the background of the study, then Section 1.3 explains the basis of the research in terms of contributions from previous and ongoing research projects, next Section 1.4 outlines the goals and the research questions, and Section 1.5 describes the structure of the thesis.

1.2 MOTIVATIONS AND BACKGROUND OF THE THESIS

The research interest behind the thesis concerns in particular *how knowledge processes can be supported in innovative and knowledge intensive environments, with a particular emphasis on the role of ICT*. Knowledge management of intellectual capital has become a central theme in today's business environment and a commonly cited source of competitive advantage (Garvin, 1993, Drucker 1988). In more detail, the motivations behind the study can be referred to:

- *Globalisation and enlarged competition*: to survive in an increasingly demanding and global environment, companies have to compete on how they exploit their intellectual capital. This entails developing and exploiting tools to manage knowledge in increasingly complex networks of relationships both inside and beyond their borders. This issue is today well perceived by knowledge-intensive organisations, such as those competing in professional services or high technology, and in all organisations that have to deal with networks of dispersed knowledge workers. (Corso et al. 2002).
- *Emergence of new organisational models*: the shift to process and project-based organisational structures, and the consequent diminished resources for functional departments and other traditional knowledge-creating units, has reshaped the traditional organisation of companies. At the same time, new alliances among customers, idea generators, and sponsor/developer organisations create temporary and permanent dynamic networks between organisations, which can be extremely important, and new knowledge sources (Osterloh and Frey, 2000; Holland et al. 2000).
- *Availability of new ICT technologies*: new Information and Communication Technologies (ICT), and especially those based on web technologies, provide companies with new opportunities for managing knowledge, shifting many of the traditional boundaries to communication and the sharing of knowledge (Pentland, 1995; Newell et al. 2000).

These changes have created new opportunities and pressures: individuals work mainly in multidisciplinary and temporary groups and therefore have less exposure to functional knowledge. Specialists are encouraged to develop skills needed to carry out liaison and other integrative roles as well as to develop specialist skills and in-depth expertise. The result is that knowledge workers are increasingly required to take care of their own continuous professional development with little contribution from the company other than providing professional challenges and stimuli (Iansiti, 1994; Holland et al. 2000). Moreover, people belonging to a specific unit or organisation are more likely to be employed on a partial and temporary base. Knowledge workers are forced to find answers to their own security and belonging needs, in alternative communities or networks of peers sharing the same professional interests and expertise (Drucker, 1988).

These trends explain why Knowledge Management (KM) has become one of the hottest issues in management research and practice. Contributions come from different streams in literature and have addressed the topic according to their specific interests and backgrounds. The main streams are: organisational learning, innovation management, strategy, knowledge management, and ICT management (see Chapter 2). Zack (1999) points out, in particular, how ICT management literature has recently addressed KM as a really challenging issue: many technologies have been developed (i.e. artificial intelligence, push technologies…), but at the same time their application is focused on information management and sharing, and their testing is focused on the functionalities and not on the impact on the organisation and processes. Conversely, literature on organisational learning and innovation management has addressed, in a very conceptual way, the issues of the process of individual and organisational learning (Kim, 1993), of the levels of learning (Argyris and Shon, 1978; McKee, 1992), and how learning is related to improvement in the organisation (Bartezzaghi et al. 1997). Two main issues remain critical: most of the contributions do not operationalise the concept of learning, which therefore remains a phenomenon difficult to measure and to manage. Secondly, few empirical studies can be found in the literature.

According to De Maio et al. (1994), the stages of in the development of a discipline can be represented as in figure 1.1:

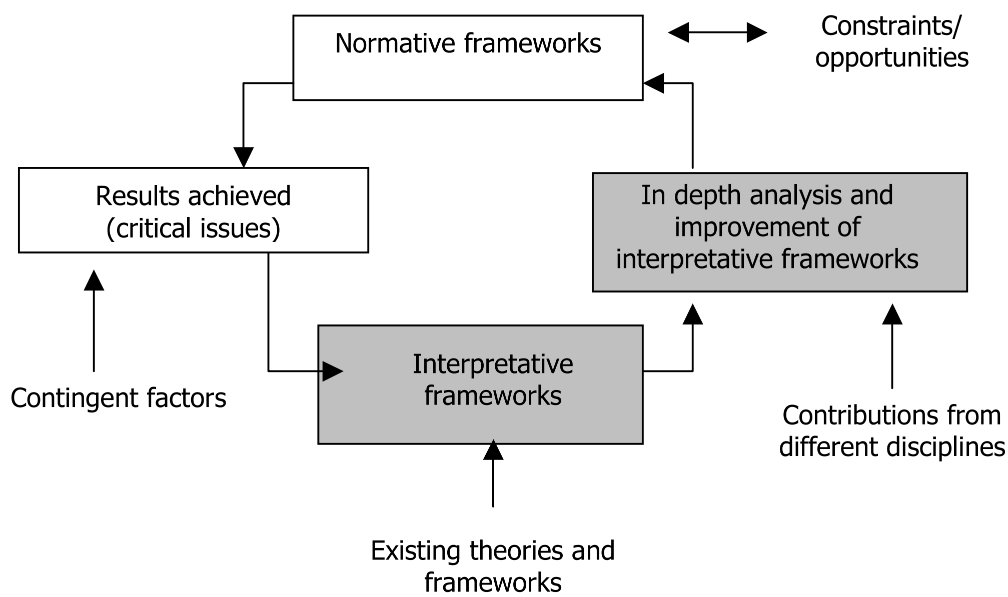

Figure 1.1: Cycle of development of a new discipline (source: De Maio et al. 1994, p.XII)

According to this model, the starting point is determined by the observation of the critical issues and problems emerging from the field. These critical issues are interpreted through existing theories and are sometimes enhanced through new frameworks from other disciplines. Results achieved from the interpretation of the reality then allow the development of normative frameworks.

The scope of this thesis is highlighted in 1.1 (grey boxes). The goal, as will be explained in Section 1.4, is to investigate how an organisation can support knowledge processes in innovative environments. Due to new trends in the competitive environment (globalisation, new organisational models, new ICT) knowledge management has been accepted as relevant for the success of organisations. The starting point of this thesis is therefore the analysis of this issue through existing theories, referring also to more recent contributions from ICT and knowledge management literature. The research will then move forward to new investigations in order to develop an interpretative framework on knowledge management and so to contribute to theory.

1.3 THE BASIS OF THE STUDY

The research is a part of the collaboration between the Faculty of Business and Public Administration of the University of Twente and the Department of Management Engineering[1] of Politecnico di Milano. Building on this collaboration, several research projects (either carried out jointly or discussed in terms of possible relationships) can be considered as the basis of the present study: some of them were carried out at the University of Twente, others at Politecnico di Milano, and others within the CInet network (as summarised in 1.2). Moreover, results coming from a previous joint research project (CIMA) involving both Politecnico di Milano and the University of Twente, and a PhD thesis related to the same topic (Gieskes, 2001), form a very important background to this thesis. In this section, first of all, a brief overview of relevant research at the University of Twente, Politecnico di Milano and within CInet network[2] is provided. Then a short description of the CIMA project (and related PhD work) is provided in order to highlight how the current research questions are related to it.

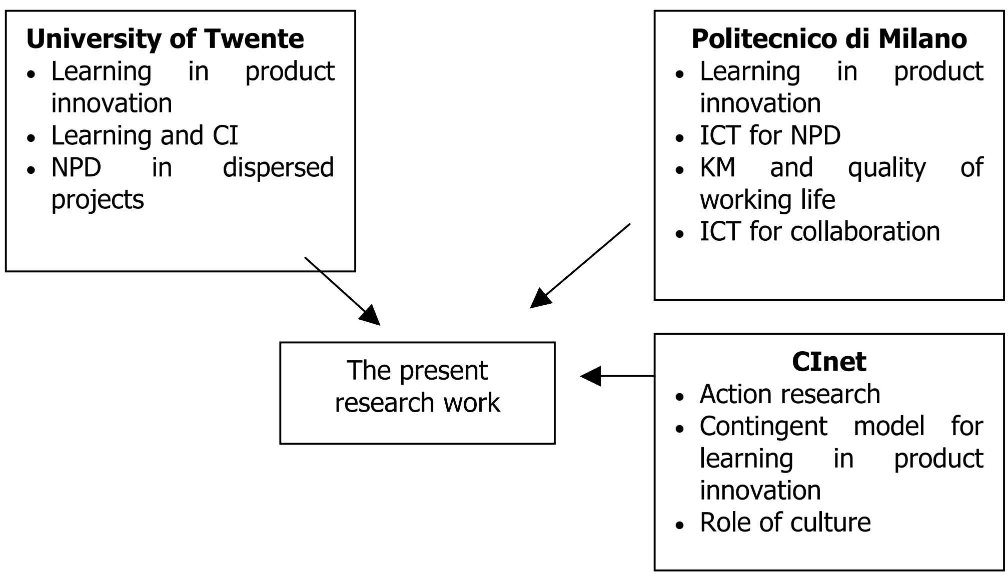

Figure 1.2: The basis of the study

Research works carried out by the University of Twente

Projects developed and ongoing at the University of Twente that have contributed to this research are:

- Co-Improve project, which is an ongoing project involving both Politecnico di Milano and the University of Twente and it is focused on knowledge management within the supply chain. (Cagliano et al., 2002).

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1 In particular MIP Politecnico di Milano, which, together with the Department of Management Engineering represents the School of Management of Politecnico di Milano.

2 The Continuous Innovation Network (CINet) is a global network set up to bring together researchers and industrialists working in the field of Continuous Innovation. CINet is a continuation of the European Continuous Improvement Network, which started as a Eureka project (EU 1222) in 1994. Several research projects funded by the EU involved partners of CInet including Politecnico di Milano and the University of Twente
(www.continuous-innovation.net).

- CUTE (Continuous Improvement Using Information Technology towards Excellence): the development of a software-aided methodology to support especially small and medium companies with the development of a sustained CI process (Gieskes et al., 1999).
- Managing collaborative NPD (Faber, 2001).
- Qualitative case study research in new product development (de Weerd-Nederhof, 2001).
- Developing a typology for continuous improvement activities (Rijnders, 2002).

Research works carried out at Politecnico di Milano

Related projects carried out by Politecnico di Milano, are:

- The theory of organisational learning in innovative contexts (Bartezzaghi et al. 1997).
- The model of product innovation (Bartezzaghi et al., 1998).
- The development of a survey concerning the use of ICT tools for new product development (Corso and Paolucci, 2000).
- SALTSA network: aimed at analysing how the management of knowledge enterprises can support the quality of working life (Löfberg, 1996; Stebbins and Shani, 1995).
- TOM project (Technology Organisation and Management). A national funded project investigating how technology, organisation and managerial systems can foster knowledge processes of SMEs (Corso et al. 2002; Cainarca et al., 2002).

CInet network

Other research projects have been carried out by the CInet network, which mainly address issues of interest to this thesis are:

- Role of culture in managing product innovation (Corso et al, 1998);
- A contingent model for knowledge processes (Chapman et al., 2001);
- Action research (Coughlan and Coghlan, 2002) and Co-Improve.

CIMA project and previous PhD work

Of particular relevance for this thesis are the results deriving from the CIMA (Continuous Improvement for global innovation MAnagement) project that involved both the University of Twente and Politecnico di Milano from 1997 to 1999. The project developed a model for learning and continuous improvement (CI) in Product Innovation (PI) Processes. This model can be considered an important input for this thesis as it deals with the variables that stimulate learning and knowledge processes. I actively participated at this project with a stronger role in the explorative (first) part of the research, carrying out the case studies and reflecting on their results in order to develop the preliminary model. This original model has been refined through the application in 70 companies and the quantitative analysis of collected data carried out by Gieskes (2001). The results allowed the identification of effective decisions that stimulate learning, the barriers to learning and the performances of learning.

Anticipating the discussion in Chapters 2 and 3, the relationship between present research work, the theoretical background, CIMA and previous PhD work, is represented in figure 1.3. The contributions will be described in detail in the thesis. However, as discussed in Section 1.2, also very practical requirements from companies (related to globalisation, emergence of new organisational models and new ICT technologies) contribute in setting the research interest of the research described in this thesis (agenda setting from practice).

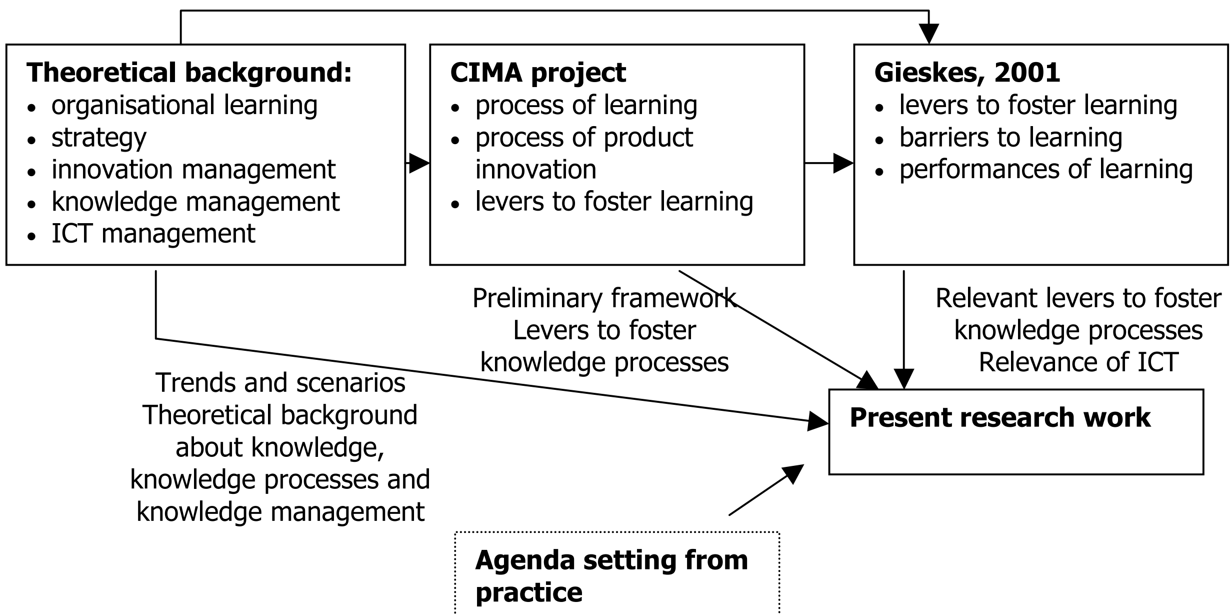


Figure 1.3: The relationship between present research and other research works

1.4 GOALS OF THE STUDY AND RESEARCH QUESTIONS

The goal of the thesis is to: *develop*, *operationalise*, *refine* and *extend* a conceptual framework about knowledge management in innovative environments. The approach followed in this thesis is a "system approach" (represented in figure 1.4) since its structure allows the highlighting of the knowledge processes, the decisions taken to manage them, and their context (De Maio et al. 1994). Knowledge (management) processes are considered as "open systems" in the sense that they interact with the external environment through their inputs and outputs. According to this approach, the inputs can be classified into two groups: the Decisions or levers (D), which are the variables that can be controlled by the actors in the system, and the Exogenous variables or contingencies (A) which they cannot influence. The output (performances) is determined by the impact on the system of the decisions taken.

Considering, in particular, knowledge management practices, the levers are all the decisions that managers implement in order to foster knowledge processes (i.e. ICT), while the outputs are the effects of knowledge processes on the organisation.

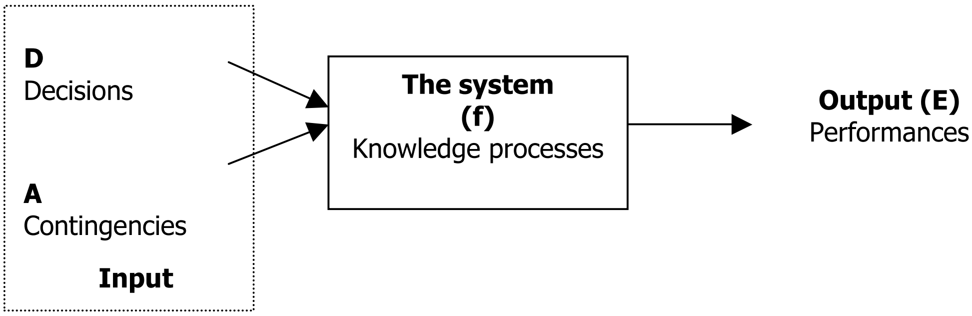


Figure 1.4: The "system approach" adopted in this thesis

Following this approach, the objectives of the thesis are:

- To investigate if sets (or "configurations") of levers are adopted by companies to stimulate knowledge processes and, if so, their effects on performances.
- To investigate the relationships among levers when one lever in the system changes (in particular if ICT changes) and the effects on performances.
- To investigate the relationship between innovation strategies (as a contingent variable) and configurations of levers (considering the effects on performances).

This leads to the following research questions:

Research questions
RQ 1: What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge intensive, innovative environments, and which performances are related to them? RQ2: Is a particular KM configuration aligned with a specific innovation strategy? RQ3: How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?

The first research question is focused on three classes of levers: ICT, organisational mechanisms and managerial systems. All these levers are considered in the preliminary theory as relevant to knowledge management. Previous CIMA research has confirmed the relevance of these levers and, specifically for ICT, has recommended further investigation (Gieskes, 2001). The system approach to levers associated with this research question is a really challenging issue, as it introduces the idea that various configurations of levers are successful, and that performance also depends on the contingent situation of the company.

The second research question addresses the analysis of how a company's innovation strategies influence the knowledge management configuration and its performances.

The first two research questions will be answered through static analysis, exploring the variables of the preliminary framework through case studies and analysing the association among the variables. In terms of the first research question, the focus is on the *internal the configuration,* concerning the second research question it is *external* but focused on one contingent variable. The third research question requires the analysis of the system in a dynamic setting: one variable (ICT) is changed and the consequent changes to the other variables are explained. This enables the investigation of configurational change and the relationships among variables.

The overall research model is summarised in figure 1.5.

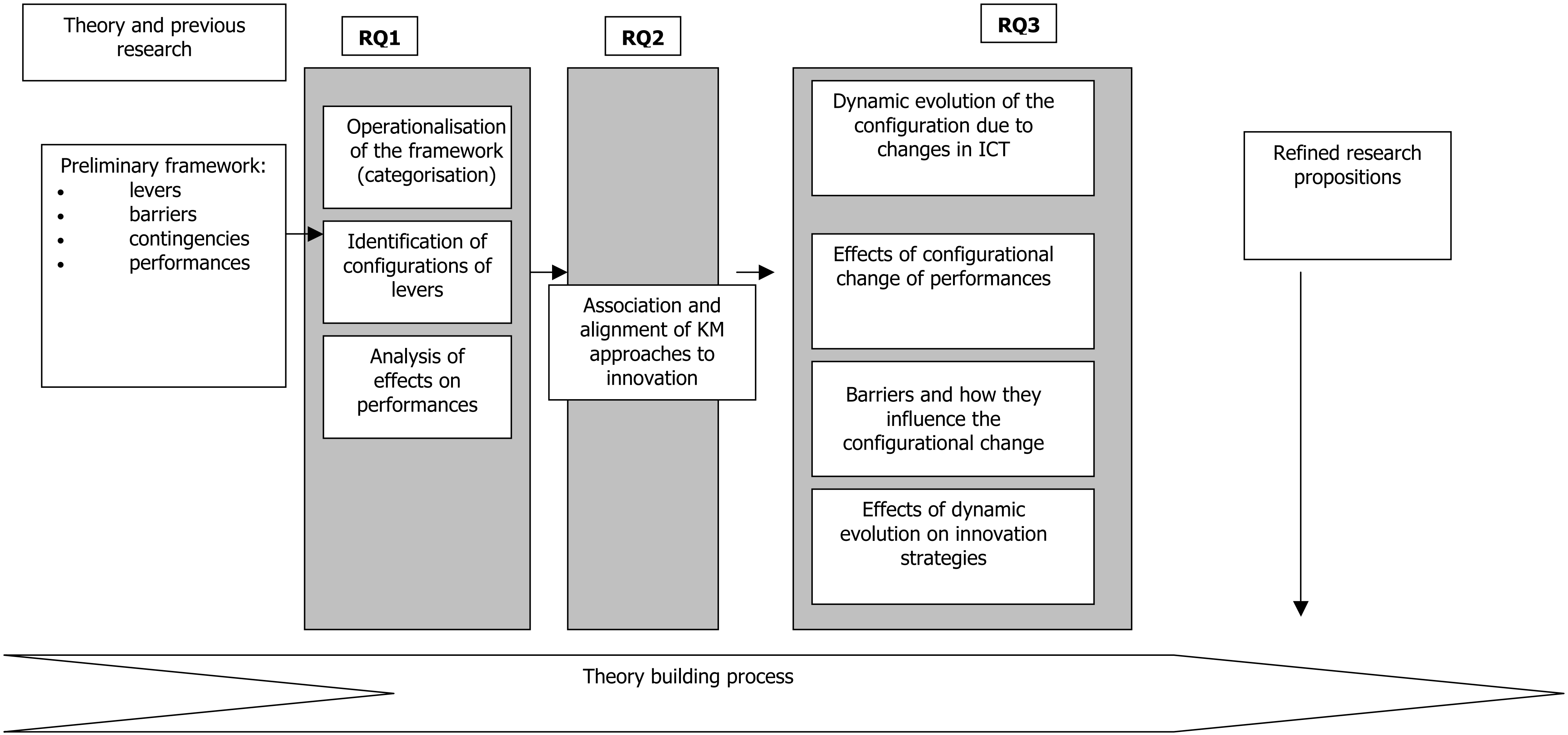


Figure 1.5: The research model

1.5 STRUCTURE OF THE THESIS

The structure of the thesis is shown in figure 1.6. The chapters are organised according to two levels of analysis: firstly, a conceptual level, where the contribution of theory and previous research is described and where conclusions are drawn; then, the empirical level of analysis, where the investigation is carried out. However, as it will be described in Chapter 4, also in empirical chapters, an explanation of results through theory will be provided, and results will contribute in deriving conclusions.

In more detail:

Chapter 2 provides an overview of contribution of literature to the topic of this thesis. Several streams will be reviewed, and their contribution, which otherwise would be extremely huge, will be focused according to the relevant research interest. The chapter also provides the definitions of knowledge and knowledge management that will be used in this research.

Chapter 3 provides a description of the previous research work that contributes to this thesis: essentially CIMA and Gieskes (2001). In terms of the theoretical background, only the relationship with the thesis will be highlighted in order to facilitate the understanding of this research.

Chapter 4 is dedicated to discussing the general line of reasoning of the research, starting from the research questions, explaining the activities carried out to answer them, and the methodology adopted. In this chapter, only the motivations behind the choices will be provided; a detailed description of the methodology adopted will be provided in the relevant chapters. Due to the peculiarity of the method, the action research approach will be emphasised.

Chapter 5 is the first empirical chapter, addressing the first research question. It is focused on an analysis in eight consultancy companies. Two main outcomes result from this chapter: confirmation and operationalisation of the model on knowledge management in innovative contexts, and a refinement and extension in terms of new results (configurations of knowledge management) interpreted through theory.

Chapter 6 is the second empirical chapter, addressing the second research question in the same setting (eight consultancy companies). The chapter is focused on understanding the relationship between configuration of levers (internal variable), and innovation strategies (contingent variable).

Chapter 7 again is an empirical chapter. It has two goals: first of all to validate and refine the results coming from the previous chapters, ad therefore focussing on the first and second research questions. Then it aims to explore the configurational change in order to develop propositions that can be refined through action research. Thus, it sets out to consolidate the results from Chapters 5 and 6, and establish the basis for Chapter 8.

Chapter 8 is the fourth, and last, empirical chapter and focuses on the development of an action research case to investigate and explain the configurational change. It primarily discusses an analysis of relationships among variables.

Finally, *Chapter 9* is a conceptual chapter, addressing the research questions, commenting on the results, the methodology, and the contributions to theory and practice.

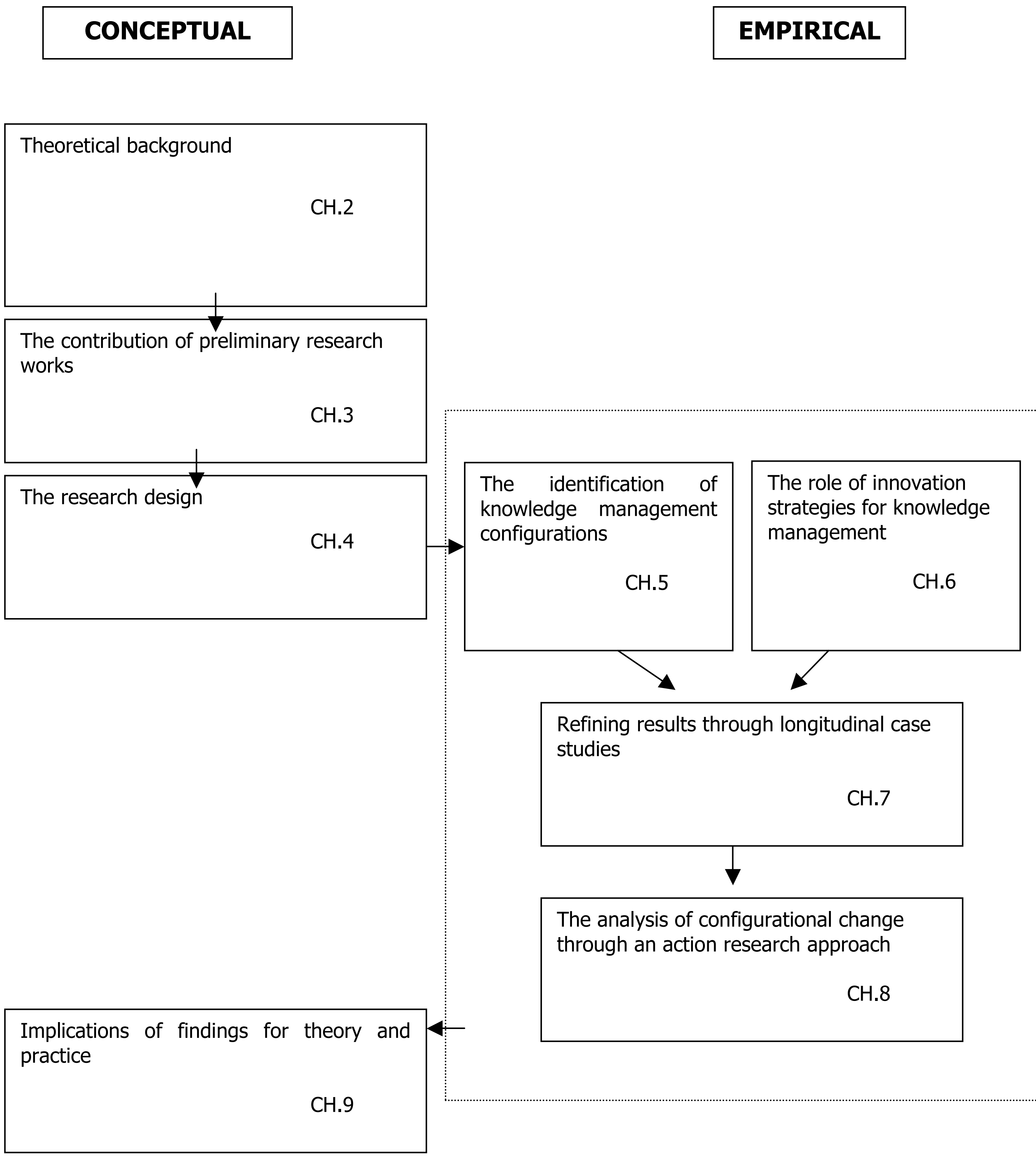


Figure 1.6: Structure of the thesis

CHAPTER TWO:
THE THEORETICAL BACKGROUND OF THE RESEARCH

2.1 INTRODUCTION

The main goal of this chapter is to describe the theoretical background of the thesis, in order to highlight the starting point of the research and then to facilitate the understanding of its original contribution.

In more detail, as pointed out in Chapter 1, the research interest underpinning this research is *how knowledge processes can be supported in innovative and knowledge intensive environments.* Therefore, literature has been investigated in order to analyse how previous studies have addressed what knowledge and knowledge processes are, especially in innovative environments, why knowledge is important for the long term competition of companies, and how knowledge processes can be stimulated.

The most difficult issue at this first stage of the research, which is also a large challenge, has been to understand and combine contributions coming from different streams of literature that address the topics of knowledge and knowledge management differently. In this chapter an overview of the theoretical background is provided. On the other hand, in Chapter 4, which is dedicated to the research design, it will be discussed how the theoretical background allows one to develop the research questions addressed in this thesis.

Literature, which is relevant for this research, comes from studies on *organisational learning* (Nonaka, 1991; Senge, 1990; Argyris, 1982). *Innovation management* is another field related to knowledge management, with a huge number of contributions from fields such as continuous improvement, R&D management, new product development (Bessant *et al.*, 1994; Nobeoka, 1993; Imai et al., 1985), and business process reengineering (Davenport, 1993). *Strategic management* has emphasised the "resource-based" view of the firm: Hamel and Prahalad's (1990) core competencies are essentially knowledge-based sources of competitive advantage (Barney, 1991; Shoemaker, 1992). More recent contributions directly address *knowledge management* and *ICT management*, especially stressing the role of ICT as a driving force contributing to the relevance and diffusion of knowledge in organisations (Zack, 1999; Storck, 2000; Holsaple and Joshi, 1999). These streams of literature are extremely large and so, in order to focus the overview on the background theory in this chapter, the contributions have been assessed in terms of their relevance:

- What is knowledge and why it is an important asset for companies?
- What are knowledge processes?
- How can knowledge processes be stimulated in innovative environments?

Figure 2.1 represents the framework of this chapter, highlighting how each stream of literature (and the topics related to the research interest) contributes to present research

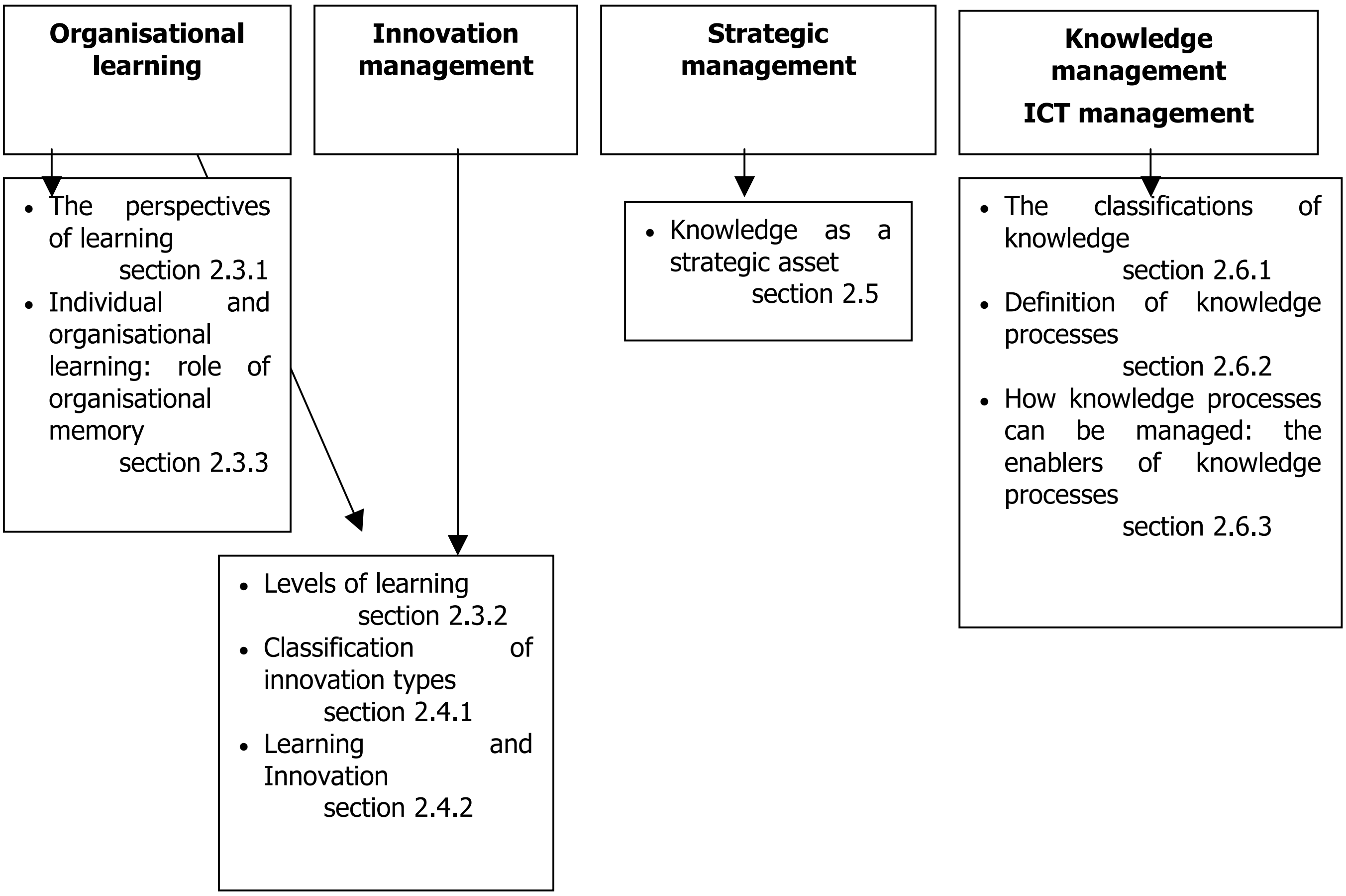


Figure 2.1: The overall structure of the chapter

2.2 KNOWLEDGE AS A MULTIDIMENSIONAL CONCEPT

Before starting to describe and analyse the theoretical background, it is important to introduce the concept of knowledge. Knowledge is a very complex concept and it is rooted in several contributions so that it is very hard to give one single definition. We will therefore resort to a multidimensional definition proposing a set of six complementary definitions that, while not singularly comprehensive, together may give an overview of how the concept of knowledge is used in management literature. In particular these definitions, which characterise the concept of knowledge, are also useful in order to understand the underpinning streams of literature.

- *Knowledge is based on human belief*. As Nonaka (1991) argues, borrowing from the Greeks philosophers, "Knowledge is a true justified belief". Knowledge, in other words, is not static, absolute and objective, but rather dynamic, relative and subjective, as it emerges from beliefs that are person-dependent. Knowledge, therefore, always involves a person who knows depending on perspectives and intentions. Organisations, as a consequence, can only learn through individuals (Nonaka, 1991).
- *Knowledge is a purposeful set of information*. Knowledge is more than information and data (Zack, 1998). Data are single observations about facts, so they are not necessarily meaningful; information

results from placing data together, including the context, in messages that are meaningful to someone (Zack, 1999,b). Knowing, finally, does not mean only having information about a certain topic, but also using it according to a certain purpose. Knowledge therefore always concerns action and is a result of purposeful human thinking. Thinking is the process that makes information useful. Thinking is the key to piece information together, reflect on experience, generate insights and use those insights to solve problems. In particular, as Fissher and Weerd-Nederhof (2001) point out, this definition is related with the potential meaning of knowledge. In theory, the value or meaning of knowledge is retrospective: you can be sure that information is valuable for the organisation after it has been used again. Therefore the firm should be able to understand *a priori* which information or knowledge is expected to be useful in the future, and organise it according to future applications.

- *Knowledge is dynamically accumulated over time*. A different body of knowledge (*knowledge base*- Metcalfe and Gibbons, 1989) at the individual or organisational level derives from different paths or trajectories of accumulation of information. The uniqueness and competitive advantage of an organisation may be explained in terms of the unique process of knowledge acquisition, articulation and enhancement (Dodgson, 1993, Walsh and Ugson, 1991). This knowledge accumulated over time creates *firm specific resources* (Penrose 1959, Wernerfelt, 1984; Rumelt, 1984; Barney, 1991; Peteraf, 1993; Collis and Montgomery, 1995) or core competences (Prahalad and Hamel, 1990) that are the key to understand company strategy and results. The stock of knowledge that one company controls at a certain time also influences its ability to learn. Cohen and Levinthal (1990) introduce to this aim the concept of "absorptive capacity": the ability of a firm to recognise, create, store and reuse critical knowledge according to the prior level of relevant knowledge (Bhatt, 2001, Teece et.al, 1997). Over time the knowledge base is operationalised and embedded in routines, which include "the forms, rules, procedures, conventions, strategies and technologies around which organisations are constructed and through which they operate. They also include the structure of beliefs, frameworks, paradigms, codes, cultures and knowledge that support the formal routine" (Levitt and March, 1988, p. 320).
- *Knowledge circulates at organisational levels*. People do not learn on their own: transfer of knowledge among individuals within a certain community helps in creating knowledge. In communities people come to embody ideas, perspectives, prejudice, language and practices of such a community (Kuhn, 1970). Knowledge circulates through communities. The organisation can facilitate this process encouraging and co-ordinating communication and mutual learning (Dogdson, 1993). The transfer of knowledge from one community to the other can happen in both tacit and explicit forms (Polanyi, 1966; Nonaka and Takeuchi, 1995).
- *Knowledge can be shared in tacit or explicit forms:* Explicit, or "codified", knowledge refers to knowledge that is transmittable in formal, systematic, language. It is discrete, or "digital", and it is captured in records of the past such as libraries, archives, and databases and is assessed in a sequential basis. According to Polanyi (1966), however, most knowledge remains in tacit forms, deeply rooted in a specific context. It entails knowledge which is difficult to express, formalise or share in an explicit way. According to Nonaka and Takeuchi (1995), it involves both cognitive (i.e.

mental models which include schemata, paradigms, beliefs that help individuals to perceive and define their world) and technical (i.e. concrete know-how, crafts, skills to apply in specific contexts) elements. Lubit (2001) suggests classifying tacit knowledge in four categories: a) hard to pin down skills-"know how", b) mental models, c) ways of approaching problems-the decision tree people use- and d) organisational routines. Tacit knowledge is intangible and it is difficult to imitate, so according to the strategic management theory, referred to as resource based view, it is potentially an important asset for creating competitive advantage (Wernerfelt, 1984; Rumelt, 1984; Barney, 1991; Peteraf, 1993; Collis and Montgomery, 1995; Meso and Smith, 2000). Explicit knowledge is knowledge that can more easily be described and transferred using documents, artifacts or software and can be more promptly transferred and shared. Tacit and explicit knowledge are not totally separate but mutually complementary entities (Nonaka, 1994). The assumption is that knowledge is created through the interaction between tacit and explicit knowledge.

- *Knowledge is created at the boundaries of old through an incremental process (*McDermott, 1999). The process of creating knowledge relies on combination, comparison and synthesis of what people already know in terms of experience, abilities, information and explicit knowledge. The output of the process of learning is new knowledge. Although knowledge can allow radical changes and discontinuous innovation, the process of learning through which knowledge is acquired is always somehow continuous and incremental (Hedberg, 1981).

2.3 THE ORGANISATIONAL LEARNING CONTRIBUTION

As a result of the definitions of knowledge provided, most of the literature focuses on the definition and analysis of the process of organisational learning, and considers knowledge as a result of this process. Therefore, to understand the concept of knowledge and its typologies, it is necessary to deepen some characteristics of learning[3].

In literature several definitions of learning have been set, as shown in figure 2.2. Although these definitions approach learning differently, the idea of learning as a cycle is implicit: learning is needed for improvement, people act in the organisation and reflect on their actions (Deming, 1986; Kim, 1993; Bartezzaghi et al. 1997).

From organisational learning theory, three main topics can be derived that are relevant for knowledge processes and management: the perspectives of learning, the levels of learning (which is addressed also by Innovation management literature) and the relationship between individual and organisational learning. The *perspectives of learning* introduce the main characteristics of knowledge processes, the *levels of learning* are extremely important to understand how knowledge processes take place in innovative environments and finally *individual and organisational learning* are discussed briefly in order to highlight the relationship between individual and organisational memory (which is one of the critical topics in knowledge processes).

[3] To get a more detailed analysis of organisational learning issues, efer to Gieskes' PhD thesis (2001).

Author	Definition
Argyris (1977)	Organisational learning is a process of detecting and correcting errors
Argyris and Schon (1978)	Organisational learning involves the detection and correction of errors and it involves repeated testing, construction and reconstruction of knowledge
Daft & Weick (1984), after Duncan and Weiss (1979)	Organisational learning is a process by which knowledge about action-outcome relationship between the organisation and its environment is developed
Fiol &Lyles (1985)	Organisational learning is the process of improving actions through better knowledge and understanding
Levitt & March (1988)	Organisations are seen as learning by encoding inferences from history into routines that guide behaviour
Stata (1989)	Organisational learning entails new insights and modified behaviours
Kim (1993)	Organisational learning is increasing an organisational capacity to take effective action.
Dodgson (1993)	Learning can be described as the ways firms build, supplement and organise knowledge and routines around their activities and within their cultures, and adapt and develop organisational efficiency by improving the use of the broad skills of their workforces.
DiBella et al.(1996)	Organisational learning is the capacity (or processes within the organisation) to maintain or improve performances based on experience
Leroy and Ramanantsoa (1997)	Organisational learning is the collective phenomenon of the acquisition and development of cognitive and behavioural skills, knowledge and know how resulting in a more or less profound and durable modification of the way organisations are managed.

Figure 2.2: Definitions of learning (from Gieskes, 2001, p.35)

2.3.1 Perspectives on organisational learning

According to literature, four perspectives of organisational learning emerge which are summarised in figure 2.3 (Shrivastava, 1983). From these perspectives on learning it can be concluded that a general distinction arises concerning the concept of learning as behavioural change or as cognitive change (Leroy and Ramanantsoa, 1997).

- The view of learning as *behavioural change* is based on the hypothesis that it is impossible to understand people's mental state. Observations should be limited to what can be seen and should try to discover general laws by relating the stimuli received by an individual to the characteristics of his/her behavioural response (Cyert and March, 1963; Fiol and Lyles, 1985; Levitt and March, 1988; Nelson and Winter, 1982; Leonard Barton, 1992, March, 1991). At the organisational level, the behaviourist model is focused on the relationship between the corporate structure and the environmental change, so the organisation is seen as an *adaptively, rational system that learns from experience* (Cyert and March, 1963) and learning is an *adaptive process that maintains the survival of the firm* (Fiol and Lyles, 1985). Organisations are also seen *as systems of routines*: organisational behaviour is a function of its "routines" which are devices for reducing different and multiple stimuli by means of standardised responses. The routines are outcome of learning and enable the organisation to cope with the disturbing consequences of newness by referring new stimuli to situations that have already been dealt with (Cyert and March, 1963, Levitt and March, 1988, Nelson and Winter, 1982). By limiting the range of responses, routines are economical for the organisation but they also threaten it with inertia (Leonard Barton, 1992, March, 1991).

Organisational learning perspectives	**Core ideas**	**Major contributing authors**
Adaptive learning	Organisations adapt to changes in the environment by readjusting their goals, attention rules and search rules	Cyert and March (1963) Cangelosi and Dill (1965) March and Olsen (1976)
Assumption sharing	Organisational theories in use result from shared assumptions. Learning involves changes in these theories	Argyris and Schon (1978) Mitroff and Emshoff (1979)
Development of knowledge base	Learning is a process by which knowledge about action-outcome relations is developed	Duncan and Weiss (1979) Dutton and Duncan (1981)
Institutionalised experience effects	Learning curve extended to managerial decision making	Boston Consulting Group (1968) Abernathy and Wayne (1974)

Figure 2.3: Perspectives on organisational learning (from Shrivastava 1983, p.10)

- The perspective of learning as cognitive change is focused on the need of considering the internal complexity of the learning subject, analysing what occurs inside the "black box" (Newell and Simon, 1972; Davis, 1992; Duncan and Weiss, 1979; Huber, 1991). One main characteristic of the cognitive approach is that it dissociates changes in the state of knowledge from changes in the organisation or individual behaviour (Duncan and Weiss, 1979), so that learning does not necessarily result in observable changes in behaviours (Fiol, 1994).

Current studies try to overcome this distinction between cognitivism and behaviorism, interpreting it through the concept of learning levels (Argyris and Shon, 1978, Dodgson, 1993, Duncan 1974, Fiol and Lyles, 1985, Hedberg, 1981, Kim, 1993, Senge, 1990). In other words these studies start from a cognitive approach, but the initial distinction between observable behaviour and invisible cognitive changes is transformed into a distinction between lower level learning and higher level learning (as explained in Section 2.3.2).

2.3.2 Levels of learning

A number of studies introduce the concept of levels of learning. This concept is relevant for this thesis as it attempts to overcome the classical distinction between behavioural and cognitive perspectives of learning, and furthermore it is essential to deal with learning and innovation (Section 2.4.2).

The levels of learning were first introduced by Bateson (1972). Figure 2.4 provides a brief summary of the main contributions that address the issue of levels of learning.

Reference	Levels of learning	Perspective
Bateson (1972) Argyris and Schon (1978)	Single loop; Double Loop; Deutero Learning	Distinction based on impact on cognitive level
Fiol and Lyles (1985)	Lower level learning; Higher level learning	Distinction based on the effect on behaviours or cognition, duration and scope
Senge (1990)	Adaptive learning; Generative learning	Coping vs creating
Dodgson (1993)	Strategic learning; Tactical learning	Coping vs creating
Hedberg, (1981)	Adjustment learning; Turnover learning; Turnaround learning	Distinction based on the effect on behaviours or on the stimulus response interpretation system.
McKee (1992)	Single loop; Double loop; Deutero learning	Distinction based on impact on cognitive level and relationship with the degree of innovation

Figure 2.4: The levels of learning

From an organisation theory perspective Bateson (1972) and Argyris and Schon (1978) introduce a threefold distinction: single loop, double loop and deutero learning. When an error is detected and corrected, it permits the organisation to carry on its present policies or achieve its present objectives, and then the error-detection-and correction process is on the single loop learning level. Double loop learning occurs when one error is detected and corrected in ways that involve the modification of an organisation's underlying policies and objectives. When an organisation engages through deutero learning, its members learn about previous learning contexts. They reflect on, and inquire into, previous episodes of organisational learning, or failure to learn (Argyris and Schon, 1978).

Similarly, in management theories, Fiol and Lyles (1985) distinguish *higher* and *lower* level of learning. Lower level learning occurs within a given organisational structure and a given set of rules. It leads to development of some shot term and rudimentary "association of behaviours and outcomes" which have only limited impact on the organisation. It is mainly the result of repetition and routines, and involves association building. High level learning, on the other hand, aims at adjusting overall rules and norms instead of behaviours and specific activities. The effect is long term and involves the organisation as a whole. This distinction is rather coherent with the one introduced by Senge (1990) between *generative* and *adaptive* learning, focusing on the level of change of associated assumptions, and Dodgson (1993) between *strategic* and *tactical* learning.

The levels of learning can explain how learning takes place in innovative contexts (Section 2.4.2). Hedberg identifies three learning modes: *adjustment learning* can happen when the worldview remains the same and temporary changes "*can be handled inside the behaviour repertoire*"(pp.10). It occurs when the change in organisation-environment relationship is limited and reversible. It is just an adjustment of parameters or rules, which is very fast, and often routinised. *Turnover learning* concerns significant and partially irreversible changes in the relationship between organisation and environment, as it refers to a change in the interpretative system and combination of responses from the organisation itself. In this case unlearning and new behaviours arise so that the process can be very difficult and time consuming. Finally, *turnaround* *learning* concerns substantial and irreversible changes in the relationship between an organisation and the environment as it involves the meta-systems that handle stimuli and responses. The process is very difficult but it is rapid when the change occurs.

McKee (1992) relates the levels of learning as described by Argyris and Schon, in a cybernetic model of product development, considering the relationship with the degree of innovation. The model involves information inputs in terms of information obtained from the environment, the decision network (i.e. the group who has to take a decision on a certain issue), organisation norms and technologies (i.e. the accepted "way to do things around here" and coincide to what Argyris and Schon (1978) and Hedberg (1981) identify as theories in action) and product outputs. *Single loop learning* occurs when the decision network utilises information inputs in order to modify the product, but without modifying current organisational norms and technologies. *Double loop learning* occurs when a change is required in organisational norms and technologies. The third level (*deutero learning*) can be considered as a meta level as it does not refer to a specific task of the organisation (i.e. a specific innovation), but to a class of tasks (learn to innovate).

The levels of learning are assumed to be hierarchical whereby deutero learning includes double loop, which includes single loop. *Incremental innovation* requires expertise focused close to operational levels, so the corresponding learning process is single loop. As *discontinuous innovation* implies a revolutionary change instead of an evolutionary change, it involves double loop learning. Norms and technologies are changing and the organisation relates to its environment in a new way. Such a change requires also unlearning (Hedberg, 1981). *Program-level innovation* requires organisations to learn to generalise innovation skills by means of organisational or "meta"-level learning.

2.3.3 Individual and organisational learning

The distinction between individual and organisational learning is a key issue in learning literature. As Dodgson (1993) points out, focusing just on organisational learning underestimates some characteristics of learning. Routines in the processes, for example, are argued to be independent of individuals who operate within them and use them. Moreover, behind the theory of organisational learning, there is the assumption of uniformity in learning processes within firms; while in complex organisations different learning processes can proceed at the same time, in different directions, at different speed.

So, as Simon (1991) specifies, the organisation learns in two ways: "1) by the learning of its members or 2) by ingesting new members who have knowledge the organisation didn't previously have…What an individual learns in an organisation is very much dependent on what is already known (or believed) by other members of the organisation and what kind of information is present in the organisational environment" (p.125). With this definition, one important element is highlighted that forms the basis of the knowledge management discipline: the role of *memory.*

Kim (1993) describes a model about the relationship between individual and organisational learning through the concept of memory. The *individual learning* is depicted as a Deming cycle (Plan do check act), it represents the creation of knowledge, and memory is located in the *individual mental models*. According to Senge (1990), mental models are collections of ideas, experiences and schemas through which individuals interpret their own reality. On the other hand, *organisational learning* is interpreted as a loop "individual believes - individual action - organisational action - environmental response" (March and Olsen, 1976). This loop is complete if the organisational response influences individual beliefs. So, if the environment changes, also individual beliefs can change, also creating different individual actions and organisational actions. This model of organisational learning is coherent with the interpretation of the organisation as an interpretation system (Daft and Weick, 1984), where organisational learning is a process of exploration (collection of data), interpretation (meaning to data) and learning (action undertaken). According to Kim's model, individual learning does not necessarily imply organisational learning. In order to fully understand organisational learning, it is necessary to introduce the concept of *shared mental models* (theories in action) that represent the memory of the organisation. Shared mental models constitute the way an organisation interprets its own world and assumes that individuals improve their mental models. This model of individual and organisational learning fits with the levels of learning introduced by Argyris and Schon (1978). Double loop learning (at the individual or organisational level) occurs when mental models are influenced, improved or changed.

Some implications of the model proposed by Kim are very important for the aims of this research work: first of all, as described, the concept of memory. Memory is not related to the technical concept of storing data and information; it is, at the individual and organisational level, a dynamic accumulation of knowledge, and refers to the concept of "theory in action". Moreover, the distinction between individual and organisational learning has been very useful in representing situations where learning does not occur as barriers to learning arise due to incomplete loops at either individual or organisational or between the two levels (March and Olsen, 1976; Kim, 1993).

2.4 THE INNOVATION MANAGEMENT CONTRIBUTION

Innovation theory is a very large field of research, and "innovation" has been approached in several ways. It is not the aim of this thesis to discuss the process of innovation itself, but at the same time it is important to provide a definition of innovation, and a classification of its types (Section 2.4.1), in order to explain the classification of innovation strategies provided in this thesis (Chapter 6). Moreover, this section will discuss the relationship between learning and innovation (Section 2.4.2), which has been partially anticipated considering the levels of learning (Section 2.3.2). The goal of Section 2.4.2 is in fact to highlight which are the characteristics of learning that takes place in innovative environments.

2.4.1 The classifications of innovation types

As Boer and During (2001) point out innovation is "the creation of a new product-market-technology-organisation combination (PMTO combination). In this definition products are the tangible or intangible outputs of the organisation; market are composed of (groups of) customers; technology is the knowledge, experience, skills of people, methods, techniques, tools and equipment companies use to perform their production, support and management processes. Organisation is the whole range of structural, cultural and physical arrangement through which the work in the company is divided and co-ordinated". In figure 2.5 a classification of types of innovation is summarised.

Classification	Type of innovation	References
According to the scope of innovation	Product innovation Process Innovation Organisation innovation	Boer and During (2001) Bartezzaghi et al (1997)
According to the degree of innovation	Incremental innovation Small step innovation Synthetic innovation Discontinuous innovation Radical innovation Quantum leap	Tushman and Nadler (1986) Boer and During (2001) McKee (1992) Henderson and Clark (1990) Sakakibara (1994) Uzumeri and Sanderson (1995)
According to the impact of innovation (the who for which the innovation is new):	for the individual for the group for the company for the industry for the country/society for the world	Boer and During (2001)
According to the actors involved	Mainly internal Internal and external (involving suppliers, customers…)	Inkpen and Crossan (1995) Afuah and Bahram (1995)
According to the complexity	Modular innovation Architectural innovation	Henderson and Clark (1990) Henderson and Cockburn (1994)

Figure 2.5: Classifications of innovation

Literature provides several classifications of innovation. However, not all of them will be discussed in this thesis. In Chapter 6, two classifications will be analysed in more detail (and the innovation strategy derived), due to their strong impact on learning and knowledge processes: the classification according to the degree of innovation and the classification according to the actors involved.

2.4.2 Learning and innovation

Contributions that relate innovation and learning start from the relationship between the organisation and its environment. Daft and Weick (1984)[4], represent the organisation as an interpretation system, as depicted in figure 2.6.

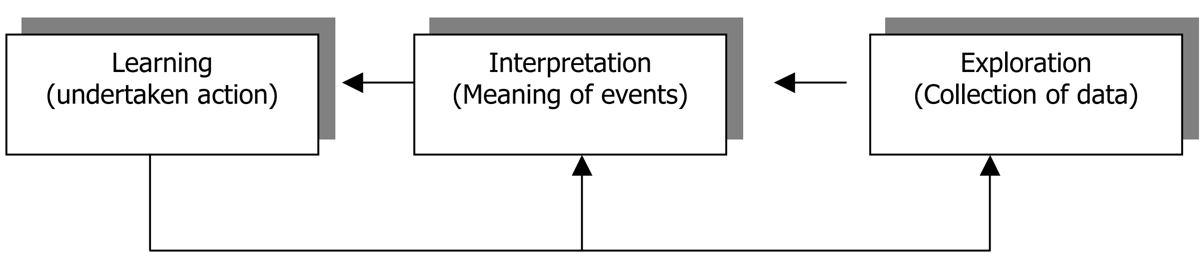


Figure 2.6: The organisation as an interpretation system (from Daft and Weick, 1984, p.286)

[4] This contribution specifically addresses stimulus-response theory

Exploration is the process of monitoring and collecting data about the environment. *Interpretation* is the process of analysis of events and the development of concepts that should be consistent with already existing understanding of the environment. *Learning* is the process of understanding the relationship between the organisational actions and the environment. According to the approach adopted by the organisation towards the environment, it is possible to classify four kinds of interpretation systems. In particular the organisations are classified according to the level of organisational intrusivity (to what extent the organisation is oriented towards the external environment or to the development of internal technologies) and to the assumptions about the environment (to what extent the environment is assumed to be analysable or not). The four approaches are represented in figure 2.7. This model is rather interesting for the purpose of this thesis as it introduces the concept of types of interpretation processes and learning systems according to their different approaches to the environment. Some issues should be noted:

- First of all the focus of this model is just on *organisation*, and the role of individual learning is not considered.
- An assumption of the stimulus-response theory is that the organisation can only react to stimuli. Hedberg (1981) highlights that equating learning to adaptation is misleading: "organisational learning includes both the processes by which the organisations adjust themselves defensively to reality and the process by which knowledge is used offensively to improve the fits between organisations and their environments" (p.3). In modelling the organisation as a closed system, learning results from the negative feedback between the environment and the organisation which aims at "maintaining the genotype unchanged " (Hedberg, 1981, p.5) and organisational learning aims at self-stabilisation (Galbraith, 1973). But, if the organisations are open systems, they can re-organise themselves, move into new markets or niches, or create more benevolent habitats (Hedberg, 1981).

	Not analysable	*Indirect sought* Constrained interpretations. Informal data. Doubts, troubles, opportunities	*Action* Experimentation, trials, coercion. Learning by doing
Assumptions concerning the environment	**Analysable**	*Conditioned sought* Interpretation within traditional boundaries. Passive discovery. Formal data	*Discovery* Formal research, making questions, collecting data. Active discovery
		Passive	**Active**

Organisational intrusivity

Figure 2.7: The classification of interpretation systems (from Daft and Weick, 1984, p.289)

- Another issue concerns the level of change in the environment (Hedberg, 1981): too much turbulence can prevent learners mapping their environment. Experimenting becomes so meaningless if the experimental situation changes too frequently. The concern for the novelty levels assumes high relevance and becomes more complex in the case of innovative processes within the company (i.e. NPD). On the other hand, too much environmental stability does not foster learning as well (Hedberg 1981).

A different perspective concerning learning and innovation is suggested by Bartezzaghi et. al. (1997) and it is focused on interpreting new product development projects as processes involving a progressive reduction of uncertainty: each new project represents, for the decision maker, a new problem, where the effects of design choices are not known in advance (Hage & Aiken, 1970; Zaltman et al., 1973; Slack et al., 1995; Bartezzaghi et al. 1997). Moreover, two different types of learning have been identified: intra project learning and inter project learning. *Intra-project learning* is learning within the single project. Problem solving within a project may go through repeated and cyclical loops, each loop seen as a sequence of the four Deming loop phases. The objective of each loop is to gather more information about the specific project in order to refine the models and take better decisions. *Inter-project learning* is a complementary approach to uncertainty reduction, exploiting experience gained in past projects. Analogous to what happens in repetitive processes or in intra-project learning, inter-project learning occurs through repeated triggering by an appropriate stimulus. Bartezzaghi et al (1997) highlight how difficult it is to discuss about learning in innovative and uncertain contexts for several reasons:

- Separation between cause and effect in past projects. Sometimes the effects of specific choices made in past projects emerge only after the project is finished (for example after the product has been launched) and the project organisation structure has been released. In such a situation the feedback from the environment is not caught and opportunities for learning are lost.
- Every project is characterised by context-specific variables, which are hardly transferable. It is very difficult to recognise the importance of a certain project and abstract knowledge that can be reused in a different one.
- Separation in time and space between past projects and future applications: if relevant knowledge has been identified in past activities, it is very difficult to transfer it in a current project, as a specific link (in terms of people, information systems or documentation) does not exist or is not formalised.

So, in innovative and uncertain contexts the learning process (figure 2.8) requires one to perform the learning cycle (Decision, Implementation, Analysis of Variances and Improvement) considering both the single loop and the double loop levels of learning (Hedberg, 1981; McKee, 1992; Argyris and Schon, 1978). In particular, the real challenge of the model, which is extremely useful for this thesis, is the modelling of the improvement phase in innovative contexts in four subphases: 1) *abstraction and generalisation*: in this phase the analysis of project feedback and variance is carried out in order to identify not context-specific issues which can be of general value and can be transferred to other projects 2*) embodiment*: in this phase, which occurs at the double loop level, the institutionalisation of lessons learnt is performed. This step is very important when learning occurs between projects: at intra-project level the feedback very rapidly provides improved solutions, while at inter-project level, more time can occur between the feedback and the future application; 3) *dissemination*: in this phase, lessons learnt have to be diffused throughout the organisation in order to generate improvements in other projects; 4) *application*: in this phase, past solutions are reused in new projects. The problem, which is very common in retrieval phases, is to recognise similar projects in order to find relevant solutions.

The process of inter-project learning implies a strong unlearning capability (Hedberg. 1981). Unlearning is a process through which learners discard knowledge and it is then possible to provide new responses to stimuli. In other words if success enforces current models, innovation requires the capability of changing current shared mental models (theories in action): i.e. unlearning. According to Hedberg, unlearning has three modes of operation: a) disconfirmation of mechanisms for selecting and identifying stimuli, so a learner no longer perceives stimuli; b) disconfirmation of connection between stimuli and responses, so people no longer know what responses to make to identified stimuli; c) disconfirmation of connection between responses, so that people do not know how to assemble responses to new situations.

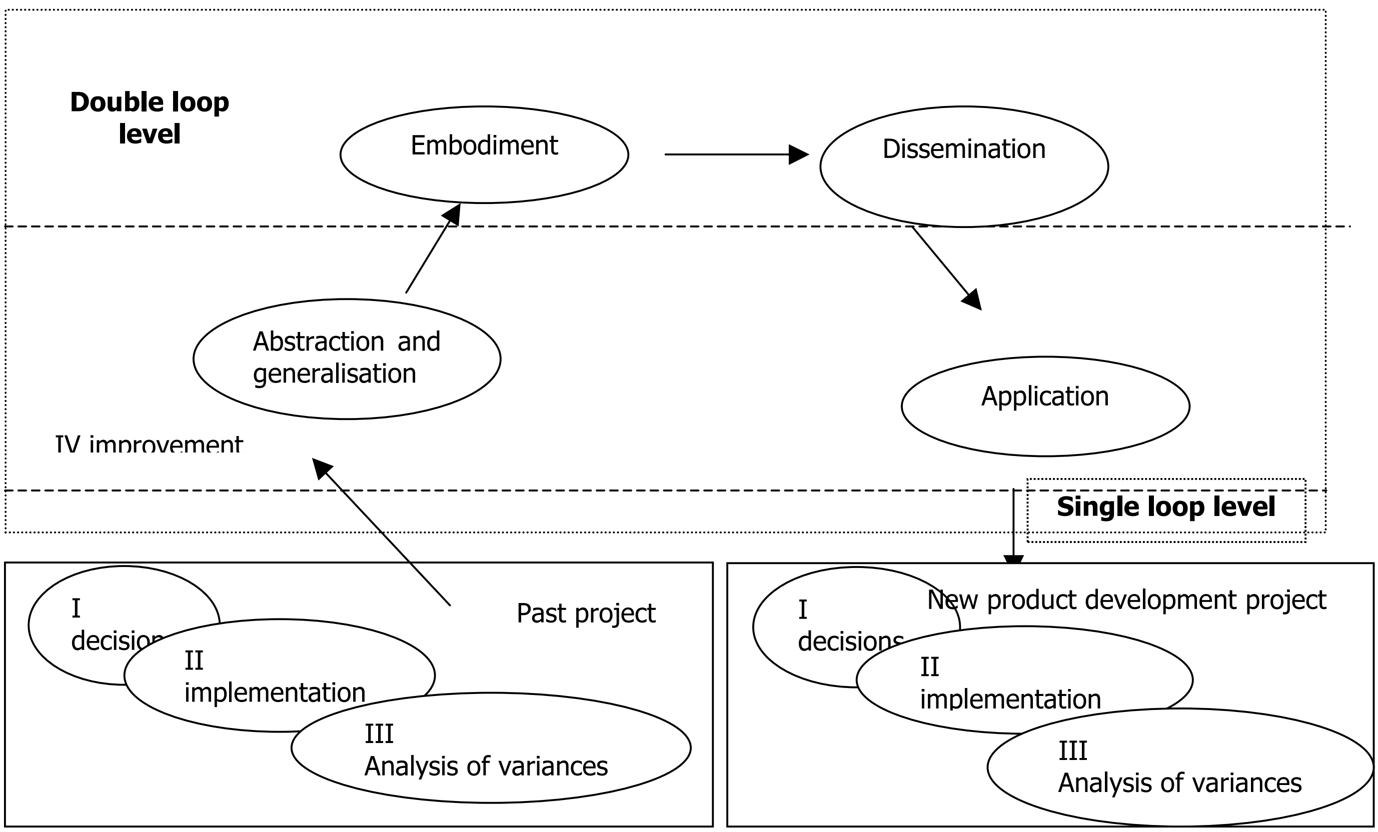


Figure 2.8: The model of Inter-project learning (from Bartezzaghi et al. 1997, p.130)

Summarising the contributions of organisational learning and innovation management described in sections 2.3 and 2.4, several issues can help in setting the stage of research about knowledge processes and knowledge management:

- Organisational learning influences people's behaviours, and can also impact on the cognitive level. Single and double loop learning levels reflect this distinction.
- The organisation learns by the learning of its members. Individual and organisational learning are related.
- What organisations and individuals learn in the organisation is very much dependent on what is already known (or believed) by other members of the organisation, and on what kinds of

information are present in the organisational environment. Individuals store knowledge in their individual memory, while memory of the organisation is reflected in *shared mental models* (theories in action).

- Learning as a cycle happens also in innovative environments, but it presents certain peculiarities to overcome the temporal, spatial and organisational barriers: the improvement phase deals with abstraction and generalisation, embodiment, dissemination and application; and it is carried out moving from the single loop to the double loop level.

2.5 THE STRATEGIC MANAGEMENT CONTRIBUTION

The main contribution of strategic management to the research interest of this thesis comes from the "resource based view of the firm". As Nonaka (1994) points out, the resource-based view (RBV) can be seen as an essential link between organisational learning literature and knowledge management literature. This approach, which is grounded in economics, explains how company's resources drive its performance in a dynamic competitive environment. The theoretical framework that underpins the RBV aims at understanding how competitive advantage is achieved, and how this advantage might be sustained over time (Barney, 1991; Penrose, 1959; Peteraf, 1993; Prahalad and Hamel, 1990; Schumpeter, 1934; Teece et al., 1990; Wernerfelt, 1984).

The principles of the RBV can be summarised as: a) the combination of *internal* analysis of phenomena within companies with *external* analysis of the industry and the competitive environment (Collis and Montgomery, 1995); b) every company is seen as a very different collection of physical and intangible assets and capabilities. They determine how efficiently and effectively a company performs its functional activities (Amit and Schoemaker, 1993; Mahoney and Pandian, 1992; Penrose, 1959; Wernerfelt, 1984); c) in order to be a source of competitive advantage, the assets should be *inimitable* (physical uniqueness), *path dependent* (the resources are unique because of their process of accumulation), *causal ambiguous* (the process of their creation is not clear), *economic deterrent* (due to the sizable investment required, or due to the limited market potential), *durable (*the resource can sustain competitive advantage over time), a*ppropriable* (the profits coming from the resource automatically flow to the "owner" of the resource itself), *rare, not substitutable, Competitive superior;* d) when the resources and their related activity systems have complementarities, their potential to create sustained competitive advantage is enhanced (Collis and Montgomery, 1995; Milgrom and Roberts, 1990; Porter, 1992) e) two assumptions of the RBV are that ex ante conditions to competition exist and that the ex post conditions to competition can be maintained (Wernerfelt, 1984; Peteraf, 1993).

According to the RBV, core competencies of the firm are the real strategic asset (Prahalad and Hamel, 1990). Core competencies are the collective learning in the organisation, which have to be identified within the company, and not in the market. (Leonard Barton, 1992). The contribution of RBV to knowledge management is related to the following issues:

- First of all to the *role of knowledge*. RBV focuses on core competences, but does not focus on knowledge within the company or in its units, which remains implicit. The critical link is made explicit by Leonard Barton (1992): the core capability of a firm is its knowledge, which characterises the company and creates competitive advantage. It can be described in four dimensions: 1) knowledge and skills of workers; 2) technological systems; 3) managerial systems; and 4) values and rules. Similarly, Drejer (2001) argues that competencies consist of hard technologies, human beings, organisation and culture; and that they can involve a single technology and a few people, or technologies in a larger organisational unit, or complex systems connecting many persons in different departments and organisational units. Moreover, Quinn et al. (1996) describe the core competence of the company as its "professional intellect".

- *The types of knowledge*: if the core capability of the company is its knowledge, it has to be rare, imperfectly imitable and non-substitutable according to the RBV. The challenge is to identify within the company which knowledge represents these characteristics. Some literature points out that only tacit knowledge can be a source of competitive advantage (Saint-Onge, 1996); other contributions argue that also explicit knowledge can be a source of competitive advantage (Meso and Smith, 2000). However, it is important to distinguish and investigate on which types of knowledge a company can leverage.
- The role of *dynamic capabilities*: the RBV does not fully describe how certain firms gain competitive advantage in situations of rapid and unpredictable change (Teece et al. 1997). In such a context, the challenge is to rely on the dynamic capabilities by which firm managers "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al. 1997).
- The *role of Top management*: finding and leveraging on the core competences of the company is mainly a management task (Nonaka, 1994). On the other hand, as literature on organisational learning has highlighted, learning occurs at every level of the company. Managers have to build organisational and technological mechanisms in order to foster learning throughout the company.
- *Focus on enablers*: the purpose of RBV is to stress the importance of core competence within the company, and to leverage on it to gain competitive advantage. Only few contributions (Meso and Smith, 2000) have tried to formalise the enablers of creating core competence (i.e. Wernerfelt, 1984).

The resource-based view is therefore focused on stating the relevance of knowledge as a strategic asset. In the following section, a more detailed overview on knowledge and knowledge management is carried out, assuming the importance of knowledge, and dealing in more detail with knowledge processes and the levers that organisations can use in order to stimulate them.

2.6 THE KNOWLEDGE MANAGEMENT AND ICT MANAGEMENT CONTRIBUTIONS

Many definitions of Knowledge Management have been proposed, including:

- KM is the systematic, explicit, and deliberating building, renewal, and application of knowledge to maximise an enterprise's knowledge-related effectiveness and returns from its knowledge assets (Wiig, 1995).
- KM is getting the right knowledge to the right people at the right time so they can make the best decision (Petrash, 1996).

- KM is bringing tacit knowledge to the surface, consolidating it in forms by which it is more widely accessible, and promoting its continuing creation (Birkett, 1995).
- KM is a set of policies, procedures and technologies employed for operating a continuously updates linked pair of networked databases (Anthes, 1991).
- KM is the processes of capturing, distributing, and effectively using knowledge (Davenport and Völpel, 2001).
- KM is the process of capturing the collective expertise and intelligence in an organisation and using them to foster innovation through continued organisational learning (Nonaka, 1991; Quinn et al. 1996; Davenport et al. 1998).

All these definitions underpin issues which partially derive from streams of literature already highlighted (organisational learning, strategic management), and that can be further developed by calling on other contributions (i.e. knowledge management, ICT management). In particular:

- The *classification of knowledge:* this is a part of the knowledge management literature and it is discussed in Section 2.6.1.
- The *phases of knowledge processes*: knowledge management aims at creating the context in which to foster knowledge processes. As it will emerge from Section 2.6.2, the phases and characteristics of knowledge processes are also related to organisational learning.
- The *enablers of knowledge processes*, which are the core element in knowledge management, are discussed in Section 2.6.3. The role of ICT, organisational mechanisms and managerial systems will be analysed in detail. The ICT management contribution, in particular, will be highlighted considering the analysis of ICT as an enabler of knowledge processes.

2.6.1 Classification of knowledge

Literature provides classifications of knowledge, which are extremely important from a knowledge management point of view allowing different categories of enablers (with specific reference to ICT) to be implemented to stimulate different types of knowledge. In figure 2.9 these classifications are summarised.

The **Epistemological classification** of knowledge refers to the distinction between tacit and explicit knowledge. According to Polanyi (1966), tacit knowledge is deeply rooted in action commitment, and involvement in a specific context. It entails knowledge, which is difficult to express, formalise or share in an explicit way. According to Nonaka (1993) it involves both cognitive (i.e. mental models which include schemata, paradigms, beliefs that help individuals to perceive and define their world) and technical (i.e. concrete know-how, crafts, skills to apply in specific contexts) elements. Lubit (2001) suggests classifying tacit knowledge in four categories: a) hard to pin down skills-"know how", b) mental models, c) ways of approaching problems-the decision tree people use- and d) organisational routines. According to RBV theory, tacit knowledge is intangible and difficult to imitate: it may be an important asset with which to create competitive advantage (Meso and Smith, 2000; Lubit, 2001). Explicit knowledge (or codified) refers to knowledge that is transmittable in formal, systematic language. It is discrete, or "digital", it is captured in records of the past such as libraries, archives, and databases, and it is assessed in a sequential basis. Spender (1996) refers to explicit knowledge stored in databanks, standard operating procedures, manuals etc. as objective knowledge. In such a classification tacit knowledge is separated into three subtypes: conscious, automatic and collective knowledge. Individual tacit knowledge can be either conscious (it can be codified, perhaps as a set of notes, and it is potentially available to other people) or automatic (implicit knowledge that is embedded in actions). Collective knowledge is tacit knowledge of a social or communal nature.

According to Nonaka (1993), tacit and explicit knowledge are not totally separate but mutually complementary entities. The assumption is that knowledge is created through the interaction between tacit and explicit knowledge. In particular, knowledge is created through four patterns of interaction between tacit and explicit knowledge (see figure 2.10): socialisation, externalisation, combination and internalisation.

Type of classification	**Types of knowledge (Dimensions of the classification)**	**References**
Epistemological	Tacit and Explicit Knowledge	Nonaka and Takeuchi, 1995; Nonaka, 1994; Polanyi, 1966; Zack, 1998; Lubit, 2001; Spender, 1996
Ontological	Individual, Group, Unit, Company, Interfirm knowledge	Nonaka and Takeuchi, 1995 Nonaka, 1994
According to the cause-effect relationship	Declarative (know what), Procedural knowledge (know how), Causal (know why); Self motivated creativity (care why)	Quinn et al. (1996, b); Albino et al (2001); Stein (1995); Wijnhoven (1999)
According to the level of specificity	General and Specific knowledge	Zack, 1990; Court, 1997
According to the level of embedment in the organisation (Blacker, 1995)	Embrained (knowledge about); Embodied (knowledge how) Encultured (achieving shared understandings); Embedded (residing in systemic routines); Encoded knowledge: (conveyed by signs and symbols).	Fiol and Lyles (1985) and Argyris (1978) and Senge (1990). Zuboff (1988) Swidler (1986), Pettigrew (1979), Ouchi (1980) (Nelson and Winter 1982, Levitt and March 1988, Prahalad and Hamel 1990; Henderson and Clark, 1990) (Zuboff, 1988; Cooper, 1992)
According to the scope of knowledge	Component and Architectural knowledge	Henderson and Clark (1990); Henderson and Cockburn (1994); Iansiti (1994)
According to the process of knowledge management	Knowing which information is needed (know what) Knowing how information must be processed (know how) Knowing why information is needed (know why) Knowing where information can be found to achieve a specific result (know where) Knowing when information is needed (know when)	Spek and Spijkervet (1996) Liebowitz (1999)

Figure 2.9: Classifications of knowledge

Through *socialisation* an individual can acquire tacit knowledge directly from others without using language, for example through observation, imitation and practice. The key to acquire tacit knowledge is shared experience. *Externalisation* is the knowledge creation process in which tacit knowledge becomes explicit, taking the shape of metaphors, analogies, concepts or models. *Internalisation* is closely related to learning by doing. When experience through socialisation, externalisation, and combination are initialised into an individual's tacit knowledge bases, in the form of shared mental models or technical know-how, they become valuable assets. For organisational knowledge creation to take place, however, the tacit knowledge accumulated at the individual level needs to be socialised with other organisational members, thereby starting a new spiral of knowledge creation. For explicit knowledge to become tacit, it helps to have knowledge verbalised or diagrammed into documents, manuals, or oral stories.

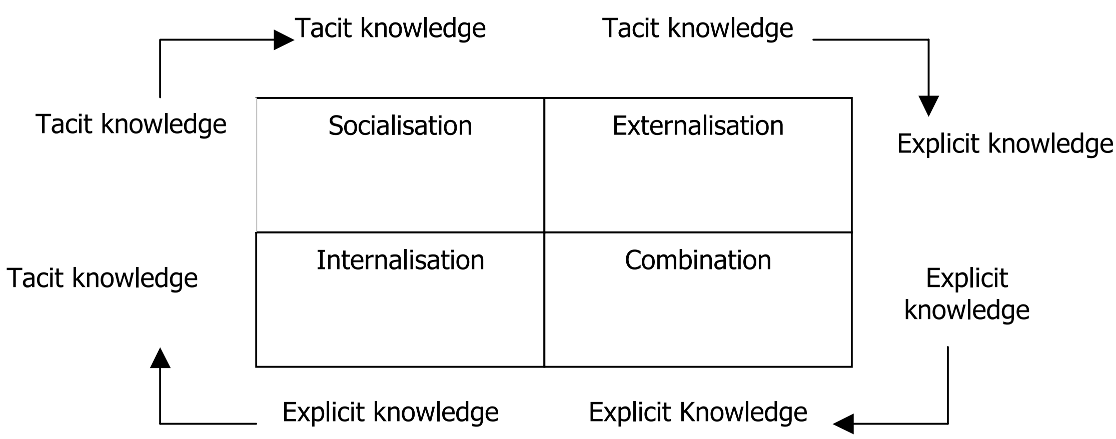


Figure 2.10: The patterns of knowledge creation (from Nonaka, 1994, p.19)

Another classification of knowledge uses the **ontological dimension** in terms of the level of social interaction. In this perspective, knowledge is created by individuals, and organisational knowledge creation should be considered as a process which organisationally amplifies the knowledge created by individuals. This classification refers to the distinction between individual and organisational learning (Kim, 1993), defining different levels of social interaction: individual level, group level, and organisational level.

According to Nonaka (1993, 1994) knowledge creation happens through the amplification of the *patterns of knowledge conversion* throughout the organisation (starting from the individual rising to the inter organisational level). This process is called the spiral of knowledge, and is enabled by five organisational conditions which are very important when the issue of knowledge generation is addressed: *organisational intention* (i.e. organisation's aspiration to its goals), *individual and group autonomy* (i.e. all individuals and groups should be allowed to act autonomously as far as circumstances permit), *fluctuation and creative chaos* (i.e. fluctuation is not disorder but change that is hard to predict; creative chaos is the creation of new knowledge and novel understandings of new circumstances), *information redundancy* and *Requisite variety* (within the organisation).

The classification of knowledge according to the **cause-effect relationship** is based on four typologies of knowledge: cognitive or declarative knowledge is termed "know what" and is the "basic mastery of a discipline that professionals achieve through extensive training and certification" (Quinn et al. 1996).

Procedural knowledge or "know how" refers to the ability to "apply rules of a discipline to a complex real-world problems" (Quinn et al, 1996). System understanding or "know why" is the deep understanding of the cause-and-effect relationship underlying a discipline (Nonaka, 1991; Quinn et al. 1996). Finally self-motivated creativity is a dynamic dimension, indicating how individuals spontaneously learn and innovate based on available knowledge.

The distinction of knowledge into **architectural and component knowledge** is primarily proposed by Henderson and Cockburn (1994). They define *component competence* as the local abilities and knowledge that are fundamental to day-to-day problem solving. *Architectural competence* is the ability to use the component competencies: that is to integrate them effectively and to develop fresh component competencies as required. Two forms of architectural competence may be particularly important as sources of enduring competitive advantage: the ability to access new knowledge from outside the boundaries of the organisation, and the ability to integrate knowledge flexibly across disciplinary class boundaries within the organisation.

Finally, Blacker (1995) relates the types of knowledge to the way an organisation approaches familiar or novel problems as represented in figure 2.11:

	Focus on Familiar problems	**Focus on Novel problems**
Emphasis on collective endeavour	*(ii) Knowledge routinised organisations: emphasis on knowledge* ***embedded*** *in technologies, rules and procedures* Typically capital, technology, or labour intensive. Hierarchical division of labour and control. Low skill requirement	*(iv) Communication intensive organisations: emphasis on* ***encultured*** *knowledge and collective understanding* Communication and collaboration the key processes. Empowerment through integration. Expertise is pervasive.
Emphasis on contribution of key individuals	*Expert dependent organisations: emphasis on* ***embodied*** *competencies of key members* Performaces of specialist experts is crucial. Status and power from professional reputation. Heavy emphasis on training and qualifications.	*(iii) Symbolic-analyst dependent organisations: emphasis on the* ***embrained*** *skills of key members* Entrepreneurial problem solving. Status and power from creative achievements. Symbolic manipulation is a key skill

Figure 2.11: Organisations and different types of knowledge (from Blacker, 1995, p.1030)

This classification is not based on the distinction between tacit and explicit ("encoded" in Blacker's perspective) knowledge. Blacker states that the role of encoded knowledge cannot be considered neutral towards the other variables within the organisation. For example encoded knowledge (according to Zuboff 1988) changes the skills required to people within the organisation: the new technologies bypass the use of immediate, physical responses to situated cues; instead they require operators to interpret the symbols they represent. Thus, they require different cognitive abilities as deduction and knowledge of systems and procedure which are essential for their operation.

2.6.2 The knowledge process

Descriptions of the knowledge process are very much related to contributions in literature addressing phases of learning (Huber, 1991; Davenport et al. 1998; Quinn et al., 1996; DiBella et al., 1996). According to Huber (1991), the overall knowledge process is resolved in processes and subprocesses (as shown in figure 2.12), which have been variously addressed by several streams of literature.

KNOWLEDGE ACQUISITION is the process by which knowledge is obtained. Huber (1991) formalises five subprocesses by which the organisation can acquire knowledge. They differ according to the scope (organisation, unit, individual), to the actors involved in the process (internal, external), to the process itself (creation of knowledge, assimilation of knowledge): *Congenital learning* (1.1 in figure 2.12) is a combination of inherited knowledge at the conception and additional knowledge prior to its birth (Schein, 1984). *Experiential learning* (1.2) is related to formal organisational experiments (experimentation) (Straw, 1977; Warner, 1981). Knowledge acquisition though experimentation can be inhibited by required authorisation and political concerns. Another form of experimentation is *organisational self-appraisal* (McNamara and Weeks, 1982, Argyris, 1983, Peters and Robison, 1984), which includes all the approaches that tend to focus on members interaction and participation as critical for learning. Moreover, *experimenting organisation* (Starbuck, 1984) describes the approach of the organisation towards experimentation: organisations should maintain themselves in a constant state of change in structures, processes, domains, goals; even in the face of apparently optimal adaptation. Finally, there are two other subprocesses involved in experiential learning: *unintentional or unsystematic learning* (Cangelosi and Dill, 1965; Levinthal and March, 1981; Harrison and March, 1984), which is not based on a plan for learning, and *experience-based learning curves* (Mody, 1989; Muth, 1986).

Another subprocess of knowledge acquisition is *vicarious learning (*1.3): organisations commonly attempt to learn about strategies, administrative practices, and especially technologies of other organisations. Channels to acquire information include consultants, professional meetings, trade shows, publications, vendors and suppliers, network of professionals (Sahal, 1982; Dutton and Freedman, 1985; Levitt and March, 1988). Moreover, organisations can acquire knowledge by acquiring or *grafting* (1.4) on new members who possess this knowledge. Sometimes this happens on a large scale by acquisition of companies. The same process often underpins joint ventures (Lyles, 1988).

Finally, *Searching and Noticing* (1.5) which include *scanning, focused search* and *performance monitoring*. In particular scanning refers to the relatively wide-ranging sensing of the organisation's external environment. Two streams of literature refer to scanning: 1) in the first the unit of analysis is the organisation or department. This literature is related to strategic management and assumes that the scanning contributes to performance (Dutton and Freedman, 1985; Thusman and Katz, 1980). 2) In the second stream of literature the unit of analysis is the individual. Two main roles are investigated: first is the role of gatekeepers in R&D (Thusman, 1977; Gesterfend and Berger, 1980); and secondly is the role of upper management (Mintzberg, 1975).

Processes	Subprocesses	Subprocesses
1.0 Knowledge acquisition	1.1 Congenital learning 1.2 Experiential learning 1.3 Vicarious learning 1.4 Grafting 1.5 Searching and noticing	 1.2.1 Organisational experiments 1.2.2 Organisational self-appraisal 1.2.3 Experimenting organisations 1.2.4 Unintentional or unsystematic learning 1.2.5 Experience-based learning curves 1.5.1 Scanning 1.5.2 Focused search 1.5.3 Performance monitoring
2.0 Knowledge distribution	2.1 Initiation 2.2 Implementation 2.3 Ramp up 2.4 Integration	
3.0 Knowledge interpretation	3.1. Cognitive maps and framing 3.2. Media richness 3.3 Information overload 3.4 Unlearning	
4.0 Organisational memory	4.1 Storing and retrieving information 4.2 Computer based organisational memory	

Figure 2.12: Phases of knowledge processes (from Huber, 1991, p.90)

KNOWLEDGE DISTRIBUTION*:* A critical issue in any organisation is how to distribute knowledge to places where it is needed and can be applied (Porter and Roberts, 1976; Huber, 1982). It can also be described as knowledge transfer or knowledge diffusion to emphasise that the movement of knowledge within the organisation is a distinct experience, not a gradual process of dissemination, and depends on everyone involved (Szulanski, 1995). Some subprocesses have been identified in the literature: *Initiation* (i.e. all the events which lead to the decision to transfer-2.1), *Implementation* (the decision to proceed-2.2), *Ramp up* (when the recipient starts using the transferred knowledge-2.3), *Integration* (it starts after the recipient achieves satisfactory results with the transferred knowledge-2.4). Szulanski (1995) discusses the impediments to the transfer of knowledge within the firm. Some barriers depend on the *characteristics of knowledge transferred*: causal ambiguity is related to tacitness of knowledge and imperfect understanding of idiosyncratic features of the new context in which knowledge is put in use. It is related to a higher cost of transfer. Another element affecting the stickiness of the transfer process is unproveness (Szulanski, 1995): people working in the process do not have proven record of past usefulness of knowledge. Other barriers depend on the characteristics of the source of knowledge in terms of lack of motivation (losing ownership, lack of reward, no time) or the reliability not being perceived. Similar characteristics can be attributed to the recipient: lack of motivation, Not Invented Here syndrome, lack of retentive capacity and especially absorptive capacity (ability to assimilate and apply new knowledge- it is a function of pre-existing stock of knowledge), to which the cost of transfer is strongly linked. Finally, some barriers depend on characteristics of the context: namely, a barren organisational context and arduous relationship (in terms of ease of communication, especially when knowledge is tacit).

Another important issue concerning knowledge distribution is the directions of knowledge transfer. Bartezzaghi et al. (1998) discuss the direction of knowledge transfer in Continuous Product Innovation process (CPI) (see Chapter 3). All the directions among phases highlighted in the model constitute a very strong potential for learning and for innovation, but which can only be exploited by an active effort to design and implement adequate mechanisms to enable this transfer of knowledge.

KNOWLEDGE INTERPRETATION: Daft and Weick (1984) define interpretation as "a process through which knowledge is given meaning" and also "the process of translating events and developing shared understandings and conceptual schemes" (p.286). According to Huber (1991), the extent of shared interpretation is influenced by several factors. First of all by *cognitive maps and framing (*3.1 in figure 2.12*)*: cognitive maps vary across organisational units and responsibilities (Kennedy, 1983; Kim, 1993), and further common labels and frames are essential to interpret knowledge coming from other units (Dutton and Jackson, 1987). A second factor is *Media richness* (3.2), seen as communication "medium's capacity to change mental representations within a specific time interval" (Daft and Huber, 1987). It determines the extent, to which information is given the same meaning by the sender and the receiver, and it depends on the variety of cues and the rapidity of the feedback that the medium can convey. Miller (1978) further indicates that *Information overload* (3.3) affects knowledge interpretation capacity: interpretation is less effective if the information to be interpreted exceeds the units' capacity to process the information adequately. Finally, *unlearning* (3.4) (Hedberg, 1981) is an important process that influences knowledge interpretation.

ORGANISATIONAL MEMORY*:* As Kim (1993) pointed out: memory is the peculiar part of the learning process, but little research (and in particular empirical research) has been carried out on this issue. Huber (1991) observes how the other phases of knowledge management are strongly dependent on organisational memory: for instance knowledge acquisition depends on attention directed by previous learning stored in memory, and knowledge distribution is affected by decisions using information and knowledge contained in organisational memory.

Literature about organisational memory mainly refers to storing, retaining and the maintenance of knowledge, and the main contributions are listed in figure 2.13. The two more recent contributions highlighted in figure 2.13 are particularly relevant for this thesis, given their relationship with ICT.

- Walsh and Ungson (1991) develop an organisational perspective of organisational memory. In particular, they assume that organisations are *information-processing systems,* that process information from the environment through sensors to receive knowledge, processors to process it and memory to retain it. According to Walsh and Ungson (1991), organisational memory refers to stored knowledge from an organisation's history that can be brought to bear on present decisions. This perspective is based on the identification of storage bins and of retention mechanisms, which are behind them. Storage bins are represented by:

a) *Individuals* who retain knowledge based on their own experiences. They can retain knowledge in their own memory stores, belief structure, cause maps, assumptions, values and articulated beliefs (Kim, 1993, March and Olsen, 1976).

b) *Culture* is a learned way of perceiving, thinking, and feeling about problems that is transmitted to members in the organisation (Schein, 1984). Culture is one way to store past experiences through language, frameworks, stories, (Duncan and Weiss, 1979; Shrivastava, 1981; Demarest, 1997). It also includes *imperatives*, which are the behavioural directives that derive from the company strategy and goals (Demarest, 1997).

Theoretical orientation	**Authors**	**Means of retention**	**Maintenance of knowledge**
Management science	Cyert and March (1963)	People and files; standard operating procedures	Repeated use over time; rule enforcement
Communication	Krippendorff (1975)	People (behaviours, stories); organisational structures; records (files, databases, etc)	Maintained by enduring structures and behaviours, oral traditions, communication networks.
Organisational learning	Argyris and Schon (1978), Hedberg (1981)	People (cognitive maps); culture (norms, shared understandings)	Individuals reinforce dysfunctional behaviours through inhibitory loops
Systems theory	Miller (1978)	People (roles); artefacts (files, databases, photographs, recordings, etc.)	Maintenance of storage makers
Decision making and information management	Morgan and Root (1979)	People (oersonal knowledge; files, procedures and policies; databases; expert systems)	
Organisational behaviour	Weick (1979)	People (maps), rules; files and computers	Repeated selection of past enacted strategies
Political theory	Covington (1981)	People (natural memory); files (artificial memory)	Communication transfer between rookies and veterans; transfer of information in files to newcomers
Economics	Nelson and Winter (1982)	People (routine patterns of behaviour)	Routine reiforces routine
Organisation theory	Smith (1982)	People (behaviour); language; myths; symbols; rituals	Maintenance of traditions
Organisation and information theory	Wash and Ungson (1991) Stein (1989, 1992)	Individuals, culture, transformations, structures, ecology Schema, scripts, systems	Communication networks

Figure 2.13: Perspectives of organisational memory (adapted from Stein, 1995, p.20)

c) *Transformations*: Knowledge is embedded in transformations that occur in the organisation and in its procedures. Examples are practices from the design of the work, to selection, socialisation, budgeting, to market planning (Cyert and March, 1963; Demarest, 1997). They include *rules* as logic models that define a set of guidelines for performing in particular environment (Demarest, 1997); and *scripts* which are other mechanisms to retain knowledge and describe the appropriate sequencing of events in conventional of familiar situations (Nelson and Winter, 1982) - or in other words prescriptions for performances (Demarest, 1997).

d) *Structures*: individual roles provide a repository in which organisational information can be stored. Moreover they are the link between individual and organisational memories (Kim, 1993; Galbraith, 1973; Duncan, 1974).

e) *Ecology*: the actual physical structure or workplace ecology of an organisation encodes, and thus reveals a good deal of knowledge about the organisation (Campbell, 1979). This perspective about knowledge storing and retention is very significant as it stresses the storing of both tacit and explicit knowledge.

- Other contributions (Stein, 1992; Zwass and Stein, 1995) are mainly related to the storing of information and codified knowledge. For example, Zwass and Stein (1995) discuss the characteristics of the repositories of explicit knowledge. According to their approach, the design of the repository reflects the basic components of knowledge: *structure* and *content*. Structure provides the context for *interpreting* the accumulated content. Moreover, the basic structural element is *knowledge unit*, which is an atomic packet of knowledge content, which should be labelled, indexed, stored, retrieved, and manipulated. The knowledge units should be linked according to ordered sequences, causal relationships, and conceptual associations. Finally, repositories should strive to record significant and meaningful concepts, categories and definition (declarative knowledge), processes, actions and sequences of events (procedural knowledge), rationales for actions and conclusions (causal knowledge), circumstances and intentions under which the knowledge was developed and is to be applied (specific contextual knowledge).

Several observations emerge from literature about organisational memory: firstly it is important to note that retention is not enough to enhance and develop organisational memory. Maintenance and retrieving are equally important: memories are only maintained if an organisation has access to its knowledge and expertise, for example minimising the level of turnover. Conversely, the availability of an organisational memory is not enough to foster retrieving. An inquirer is motivated to retrieve knowledge if: a) the inquirer values what has been done in previous contexts; b) the desired knowledge exists and the inquirer is aware of the information; c) the inquirer has the ability to search, locate and decode the desired knowledge; d) the cost to locate knowledge is less than recomputing the solution from scratch (Stein, 1995). This observation relates to the role of information technology. Relying only on ICT to develop organisational memory is very limiting. Many contributions in literature have approached organisational memory only from the ICT point of view since its functionalities enhance retention in a very explicit way. Nevertheless, as emerges from the previous discussion, knowledge can be also stored in other bins than records (people, culture…) (as described in Section 2.6.3).

2.6.3 The enablers of knowledge processes

Many contributions in literature address the enablers of knowledge process as the Knowledge Management System (KMS). These contributions can be seen as belonging to two main streams: the technical perspective and the socio-technical perspective.

The *technical perspective* holds that a knowledge management system is an advanced assembly of software, and its associated hardware infrastructure, for supporting knowledge work, and/or organisational learning through the free access and increased sharing of knowledge (Hibbard, 1997; Crock et al. 1998; Lotus, 2000). In this perspective, knowledge is managed through the combination of ten key technologies as represented in figure 2.14. Further, in appendix 1 a list of the main technologies that enable knowledge processes is provided. According to this technical perspective, knowledge is equal to information (McDermott, 1999), and it has to be made explicit and encoded (Blacker, 1995). Moreover, as Meso and Smith (2000) point out, from a resource-based view, web technologies limit the strategic advantage that can be associated to knowledge they support (Section 2.5). Web browsers are common, and the web pages developed can be easily imitated; web based systems have substitutes in groupware, messaging, document management, push technologies, intelligent agents, search and retrieval and data mining technologies. Therefore, it seems that technical perspective of knowledge management cannot completely explain the success of knowledge management (Meso and Smith, 2000).

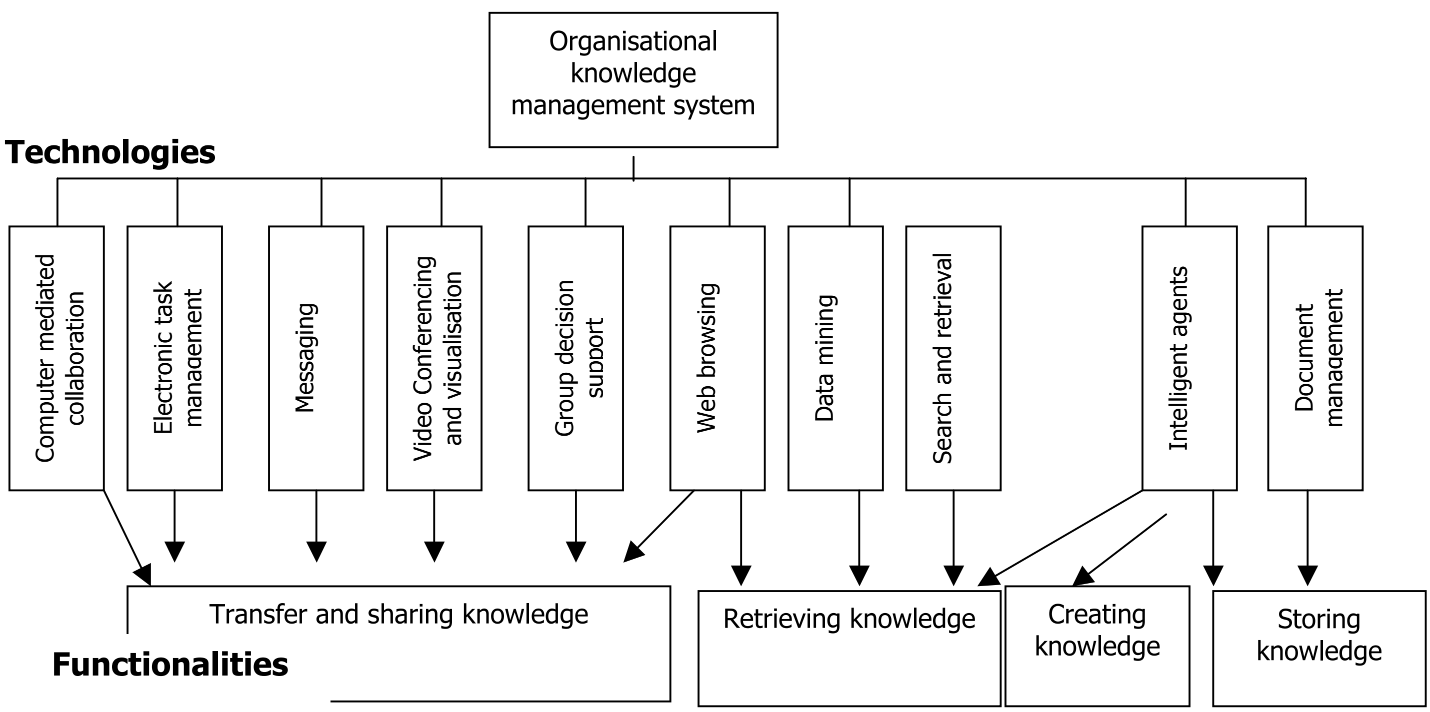


Figure 2.14: The technical perspective to knowledge management (from Meso and Smith, 2000, p.228)

As Carayannis (1998) states, while information technology can be considered as a value-adding technological infrastructure, knowledge management can be viewed as a *socio-technical system* of tacit and explicit business policies and practices. These are enabled by the strategic integration of information technology, business processes, and intellectual, human and social capital. In this thesis, the *socio-technical* perspective will be followed.

Some contributions provide models to interpret the enablers of knowledge management within the organisation. Specifically concerning inter-project learning, for example, Bessant et al. (1994) define four main enablers: clear strategic vision; diffusion of improvement objectives; development of culture for improvement; empowerment of human resources. Moreover, Bartezzaghi et al. (1997) identify three functionalities to be carried out by enablers in innovative contexts (in particular concerning inter-project learning): a) managing project feedbacks which mainly refers to an analysis of variances (analysed during the project; analysed in the project termination phase and project audits; analysed by means of job rotations); b) using vehicles for embodying and disseminating improvements (people participating in previous projects, reports and databases, organisation and technology, team working); c) adopting classification schemes which essentially refer to the ability to retrieve knowledge about similar problems.

In order to analyse enablers, this chapter will principally review three classes of levers which are the focus of the present thesis: organisational mechanisms, managerial systems and especially ICT[5]. The enablers have been classified according two dimensions:

A. The phase of the knowledge process they support: in terms of knowledge acquisition, knowledge capitalisation (organisational memory) and knowledge transfer (knowledge distribution-Huber, 1981);
B. The scope of the cluster[6] of people involved in the KM process:

- Cluster Intra: it could be only one person (an expert) or a group of people belonging to the same organisation. Should there be any dispersed workers, they will be included in this cluster;
- Cluster Group: refers to a cluster of persons belonging to different organisations, but that are part of the same group;
- Cluster Inter: this cluster extends to the people who do not belong to the same organisation, nor to the same group of firms.

First of all, organisational mechanisms and managerial systems are addressed, while the review of ICT will be developed separately given the relevance to this research work.

2.6.3.1 Organisational and managerial mechanisms for knowledge management

Zack (1999a) illustrates how to configure a company's resources and capabilities in order to leverage its codified knowledge, highlighting the importance of adequate organisational roles. In addition, the choice of a particular approach for KM has a strong synergy with the other organisational and managerial dimensions, as highlighted by Hansen et al. (1999). Holsapple and Joshi (2001) point out that the three main classes of factors that influence the success of KM are managerial, resource, and environmental. Moreover, the contingency theory asserts that, beside the resources (ICT tools and people), a KM system has to consider

[5] A wider review of enablers of knowledge management, considering other classes of enablers, has been developed in the CIMA project and will be further described in chapter 3.

6 We use the word 'cluster': it gives the idea of a group of people involved in the KM process, but is aseptic towards both the formal (i.e. teams) and the informal nature of the group itself (i.e. communities or networks of practice). This dimension of classification helps in highlighting how the enablers support the dispersion of knowledge processes (Wijnhoven, 1999).

the modalities of interaction of these resources (especially people) and their politics of management (organisational and managerial framework) (Becerra-Fernandez and Sabherwal, 2001). Therefore, organisational mechanisms (such as task assigning, coordination mechanisms) and managerial systems (such as reward systems and career paths) are integral parts that cannot be left out of an effective KMS.

Lam (2000) argues that there is an interactive relationship between dominant knowledge types and organisational form. Osterloh and Frey (2000) point out that organisational forms (especially motivational aspects) must be able to generate and transfer tacit knowledge, surpassing the limits of knowledge sharing that comes from property right beliefs (Jarvenpaa and Staples, 2001). Gold et al. (2001) examine the issue of effective knowledge management from the perspective of organisational capabilities. This perspective suggests that a knowledge infrastructure consisting of technology, structure, and also culture, are essential organisational capabilities or "preconditions" for effective knowledge management.

In this section, the main contributions from literature, in terms of organisational mechanisms and managerial systems, will be reviewed while considering the phases of the knowledge processes and the cluster they support. The major enablers coming from those contributions are summarised in figure 2.15.

Cluster 'Intra'

This cluster includes all those organisational tools which support teams, improving their KM, processes, or performances, or which help in designing new and more efficient models of teams. In this subsection, management mechanisms are also presented: managers have to design reward systems, learning processes, and opportunities for the creation of new knowledge. In the literature there are many contributions concerning the analysis and improvement of teams involving workers in the same organisation. Aspects such as team multidisciplinary, design (i.e. resource choosing, duration), and modalities for working (i.e. roles, coordination mechanisms) can be considered as tools for knowledge sharing, capitalising, and also for acquisition.

Sapsed et al. (2002) review the literature analysing the points of contact between topics of team work and of Knowledge Management; and Gray (2000) illustrates how KMS can enhance the effectiveness of teams that analyse complex, non-recurring problems, improving the way the team composition evolves. Eppler and Sukowski (2000) propose a model supporting team leaders in the enhancement of knowledge management within their teams, by improving the core team knowledge process through rules, goals, and standards of the team.

Regarding team performance, Rulke and Galaskiewicz (2000) studied the effect of knowledge distribution and group structure. They found that groups with broadly distributed knowledge have an advantage over groups with concentrated knowledge. However, this advantage decreases when groups of specialists or mixed groups have decentralised network structures. Jehn et al. (1999) explored the influence of three types of workgroup diversity (social category diversity, value diversity, and informational diversity) on workgroup outcomes. Finally, Hayes and Walsham (2001) adopted a "communities of practice" approach to examine how the introduction of a groupware application in a UK pharmaceutical company enabled and constrained knowledge working, while Edmondson (1999) presented and tested a model of team learning.

Newer team models, which are able to mostly exploit the possibilities that come from an effective knowledge management, are emerging. Ancona et al. (2002) found that traditional teams are too inwardly focused and lack flexibility. A new, externally focused, team - the X-team - is emerging: traditional team-building activities are still important, but only when combined with a greater awareness of external stakeholders and information sources.

		Knowledge management phases		
		Knowledge acquisition	**Knowledge transfer**	**Knowledge capitalisation**
Clusters	**Cluster Intra**	-X teams -recruiting -focus groups -experimentation	-mentoring and storytelling -T-shaped approach -chief knowledge officer -communities	-rules, goals, standard supporting teams -distribution of knowledge within the group -diversity -chief knowledge officer -communities
	Cluster Group	-parallel structures, linter-unit climate, goal congruence -core team, formalisation, procedural justice -cross fertilisation and cross functional integration -task design, group composition, organisational context, relation with internal and external processes -leadership -community of creation	-interpersonal exchange of people -methodologies for partners selection -clarification of roles -responsibilities and incentives -leadership -cross fertilisation and cross functional integration, -task design, group composition, organisational context, relation with internal and external processes -community of creation	-communities of practice
	Cluster Inter	-individual motivations -reputation aspects -community of practice	-individual motivations -reputation aspects -community of practice	-Communities of practice

Figure 2.15: Literature Review on Organisational Mechanisms and KM

In addition to the studies that analyse the tools that operate on the team level, or that consider the team as a KM tool, there is a stream that deals with managerial logics for KM. The implementation of an effective KMS requires the top management in an enterprise to make both strategic and organisational decisions (Darnton and Giacoletto, 1992). To Cross and Baird (2000), managers must provide structured learning processes for individuals and groups to improve business performance by KM. Under proper conditions, tools such as mentoring and storytelling can also be effective carriers of knowledge (Swap et al., 2001).

Regarding management styles, Hansen and von Oetinger (2001) assert the necessity of introducing a new logic of management by identifying the T-Shaped approach. T-shaped management requires executives to share knowledge freely across their organisation (the horizontal part of the 'T'), while remaining fiercely committed to their individual business unit's performance (the vertical part). Earl and Scott (1999) assert that, in some cases, a new class of executive dedicated to KM - the Chief Knowledge Officer (CKO)–is needed.

In some cases, the management of knowledge may require only a partial sharing of knowledge. This occurs when firms risk losing their valuable information by employees being hired by competitors (Ronde, 2001). In these situations, it would be optimal to limit the number of employees who share the trade secrets.

The requirement of organisational KM tools, although in a less systematic way, also emerges in the cooperation between different units of the same organisation. Hansen (1999) explains the role of weak ties in sharing knowledge across organisation subunits in a multi-unit organisation, while Almeida et al. (2002) compare firms (multinational corporations) to alliances and markets in cross-border knowledge building.

With respect to the creation of new knowledge, Parenta et al. (2000) analyse the role of the focus group and the possible support provided by group technologies. Management can also act in order to improve creation of new knowledge. Lapré and Van Wassenhove (2001) illustrate the case of a production line specifically set up to create technological knowledge about its production function through scientific experimentation (formal learning as opposed to learning by doing).

<u>Cluster 'Group'</u>

When increasing the autonomy of the units, the effectiveness of informal tools usually decreases and, at the same time, incentives become misaligned. As a result, the conscious introduction of organisational and managerial KM tools is critical in order to allow for the cooperation between units. Internal knowledge sharing within a multi-unit organisation requires informal lateral relations, but also a formal hierarchical structure such as coordination mechanisms for cognitive activity. This allows the growth of 'competition' between the units (Wenpin, 2002).

With full autonomy, hierarchical forms cannot be adopted. In these cases, alternative tools must be identified. Reid et al. (2001) review the literature on alliance and knowledge, and specific attention is directed to the critical alliance formation stage. Simonin (1999) analyses the role of the ambiguous nature of knowledge in the process of knowledge transfer between strategic alliance partners. Interpersonal exchange of resources between R&D scientists across organisational boundaries is a valid alternative tool. However, Bouty (2000) asserts that, in these cases, strategic resources can only be exchanged under conditions of acquaintance and mutual trust.

In defining critical requirements, selecting partners, clarifying roles, responsibilities and incentives, selecting strong, independent leadership, and making optimal use of partners, companies can use the specific knowledge and experience of equity partners and operational partners in order to get a project to market (Marchand et al., 2000).

The topic of knowledge sharing between firms (or units) with decisional autonomy is frequently discussed in relation to new product development (NPD). Interaction, information sharing and cross-fertilisation of ideas among people from R&D, production, marketing, and other functional groups are essential. However, problems arise when people with different backgrounds, experiences and interests have to interact, decide and participate in a co-creative endeavour such as new product development. While Armbrecht et al. (2001) present issues and opportunities that derive from the introduction of a KMS in R&D units, Sherman et al.

(2000) focus on the forms of cross functional integration and R&D integration of knowledge from past projects in terms of their effects on product development cycle time. Holland et al. (2000) identify critical success factors for cross-functional teamwork in relation to knowledge creation and sharing in new product development (task design, group composition, organisational context, internal processes, external processes). Jassawalla and Sashittal (2000) show that effective leadership, as well as followership, equitable distribution of power, and a concern for building collaboration among participants can make human interactions more productive, therefore facilitating the progress of ideas across the organisation.

Considering international innovation as an interfunctional activity, Moenaert et al. (2000) analyse the communication requirements that an international innovation team faces, as well as the communication capabilities (interface mechanisms) that may be adopted to initiate, develop, and launch the new product effectively and efficiently. To cope with communication requirements, organisations may create firm level capabilities (parallel structures, cross-functional and inter-unit climate, communication infrastructure, goal congruence) and team level capabilities (core team, team leadership, formalisation, procedural justice).

Focusing on transnational NPD process, Subramaniam and Venkatraman (2001) study the impact of international transfer and deployment of knowledge on firm capabilities. Sawhney and Prandelli (2000) use a sociological perspective on knowledge creation and sharing proposing a governance mechanism for managing distributed innovation, that they call the community of creation.

Cluster 'Inter'

Few contributions have addressed the knowledge management in cluster groups. If motivation for knowledge sharing within a group of firms is low, then only individual motivations allow cooperation among workers from different and unlinked firms. In these situations, neither organisational nor managerial tools are able to support knowledge management. However, reputation aspects, or simply the love of sharing, can allow the start of a spontaneous informal network among independent workers. This issue is discussed within the communities of practices approach (Wenger and Snyder, 2000), a highly important contribution to the literature. Brailsford (2001) illustrates an attempt to guide the building of a knowledge community, able to connect the various constituencies that have a stake in the success of the enterprise both inside and outside of the formal organisation.

2.6.3.2 The role of ICT to support knowledge processes

Many contributions (Zack, 1999a; Hendricks, 1999) agree on the fact that ICT, and in particular web based technologies and Lotus Notes can support knowledge processes. In particular they support the capture of knowledge through defining, storing, categorizing, indexing and linking digital objects. Further, they enhance searching for ("pulling") and subscribing to ("pushing") relevant content and presenting it with sufficient flexibility to render it meaningful and applicable across multiple contexts of use (Liebowitz, 1999).

ICT for knowledge management, as Stein and Zwass (1995) point out, has to deal with the following issues: *Chronology* (Hendricks, 1999): ICT for knowledge management should help to answer three questions "Where have we been?" (History), "where are we now?" (Management), "where might we be going?" (Future research). Next, knowledge management system should concern both *general knowledge and specific instances*. ICT should deal with *epistemology* and *ontology.* Sandoe et al. (1991) epistemologically classify approaches to knowledge management system: one can simply represent knowledge, or see the shared values and understandings that evolve among members of an organisation as illustrative of knowledge. Concerning ontology, a KMS can pertain to concrete knowledge (data or knowledge based contens), or to abstract knowledge. The use of ICT to support knowledge management *varies across the organisation*. If it concerns a horizontal organisational system it has to deal with different languages and disciplines, and also overcome social barriers (Hendricks, 1999). Finally, it should be accessible throughout the organisation.

Specifically addressing the issue of ICT functionalities, Stein and Zwass (1995) suggest a framework in order to design ICT for knowledge management:

Integrative function: aiming to support coordination and management of information across the organisation. In order to achieve this function, the system should be integrated over time and space (Linger et al., 1999). Spatially integrated systems are fully connected, thus providing access to their full content (not necessarily through centralisation). An example is through shared databases and knowledge bases. Temporally integrated systems allow transfers of knowledge between past, present ad future (Ackerman, 1994).

Adaptive function: the ability of the organisation to adapt to changes in the environment. To achieve this, the system has to recognise, capture, organise and distribute knowledge about the environment to the appropriate organisational actors. Requirements are similar to those of intelligent systems, except that the latter are not designed to store and maintain the data and histories over time. Examples are representations for the retention of cross-linked historical information on stakeholders, pattern recognition and matching, knowledge bases of user preferences and links to external sources of information.

Goal attainment function: the ability of an organisation to set goals and evaluate the degree of their fulfilment. In order to reach this, the system is required to help the organisational actors to frame and identify goal states in the context of the organisational past, store goal states, formulate strategies to achieve the goals, evaluate progress in direction of goal states, suggest alternatives based on evaluations, update goal states and store histories. Examples are templates of the context-plan-result nature, expert planning knowledge, evaluation models, company performance data, past and current performances forecasts with the variances from these expectations (some groupware and meeting memories can be used in such a way).

Pattern maintenance function: the ability of the organisation to maintain the cohesion and the morale of the workforce. In order to achieve this, as Huber (1991) states, at the *individual level* one has to contain the history of individuals, with an emphasis on project descriptions, capabilities and aspirations. Training can be supported by such a subsystem. At the *organisational level*, it is to support the preservation of organisational protocols and the values implicit in them.

Reviewing the literature about ICT according to the provided framework (phases of knowledge processes and cluster supported), it appears that most contributions focus on classification of technologies to support knowledge processes phases either independently from the supported cluster (mainly ICT literature focused on the technology and not on its application in the organisation) or related to the Intra cluster. In particular, some contributions have analysed only one phase (Merlyn and Valikangas, 1998; Hendricks, 1999), others have analysed the effect on all the phases of the knowledge process (Ruggles, 1997; Stein and Zwass, 1995). In all the cases, it is important to point out that most of the technologies enable the management of explicit knowledge (Berini, 2000).

In terms of the other clusters, only recent contributions have highlighted specific applications of ICT functionalities for "group" and "inter" clusters. The lack of contributions in this area in partially due to the only recent growth in the importance of dispersed settings and related investments.

In order to facilitate the reading and understanding of this section (2.6.3.1), and providing and overview of literature that addresses ICT for knowledge management, a preliminary discussion of the role of ICT in supporting the phases of knowledge processes will be provided, considering the main functionalities of technology. Then, a brief description of the literature contributions about ICT supporting the activities of "Intra", "Group" and "Inter" will be highlighted.

In figure 2.16, ICT to support knowledge processes is reviewed: in the first row, the technologies to support knowledge processes without reference to the cluster are addressed, and then the ones specifically indicated for clusters are provided.

Knowledge acquisition

Knowledge generation includes the creation of new ideas from an external contribution (knowledge assimilation), the synthesis of separate disciplines (knowledge synthesis), and the development of new processes (knowledge creation). From the ICT point of view, it can be useful to distinguish these three subprocesses (Ruggles, 1997). In order to support *knowledge assimilation,* ICT can help in creating links to internal and external data sources, information filtering, limited natural language processing, intelligent summarising capabilities (Stein and Zwass, 1995). Examples are *person-machines* (Ackerman, 1994), or *artificial intelligence* tools to read and summarise data (Kalpic and Bernus, 2001; Fowler, 2000) and knowledge discovery in textual databases ("*knowledge mining*"). Ruggles (1997) highlights the use of *Intelligent agents* or *search engines*: the problem is the quality, but they give access to huge amount of knowledge. Other tools for knowledge acquisition associated with these technologies include *knowledge charts*[7] and *users profiles*[8]. *Knowledge synthesis*, on the other hand, relies on bringing ideas together, often from extremely diverse sources, and recombining them in a unique way, such that new ideas emerge. Specific technologies can rely on *associative lists of word and phrases* or *flexible graphical mind or concept maps*. Finally, knowledge creation technologies are intended to push the limits of persons and groups creativity by guiding users to break away from their existing mental models. They rely on *random thought exercises* and *point-counterpoint drills.*

Knowledge capitalisation (storage and retrieval)

In order to support knowledge storage, ICT should provide means by which knowledge is perpetuated over time in the organisation. Knowledge should have certain characteristics: it should be *communicable* (understood by others), *consensual* (accepted by others for its validity and utility) and *integrated* (Duncan

[7] Knowledge charts: collection of documents, hierarchically organized, representing the organisation's knowledge and information,
[8] user profiles: they are the user's information needs classified in routine, significant, action and critical by a gatekeeper

and Weiss, 1979). Stein and Zwass (1995) highlight how the consensual aspect is critical, especially when relying on ICT. Similarly Conklin (1996b) points out the three challenges to technology for the storage and retrieving phase: 1) tacit knowledge is difficult to capture; 2) preserving documents fails to preserve the context; 3) knowledge loses its relevance, and thus its value, over time.

To design the knowledge codification and storage system, it is necessary to develop *structures* to encode different types of knowledge, *temporal languages* for indexing knowledge according to time and context, *models* to organise past and present knowledge. In other words knowledge can be codified in knowledge-bases: they are complex entities which not only contain the ideas themselves, (content) but also elements as their interrelationships, history, past usage information (Structure) (Zack, 1999b; Ruggles, 1997). Encoding knowledge it is the key challenging (Zuboff, 1988; Blacker, 1995; Stein and Zwass, 1995) and it is assumed that knowledge can be explicitly represented. Some mechanisms for encoding have been developed in artificial intelligence: scripts (sequences of events), frames (representing attributes of objects and contexts), and production rules, which can be used to represent causal knowledge. Conceptual graphs (semantic networks) allow the representation of linked concepts, as do hypertext and hypermedia**.** Ruggles (1997) highlights how codification and storage can then benefit knowledge maps: they are designed to help people know where to go to find what they need to know*.* They are useful because they create a map of interrelated sets of *contacts, documents, events* and other interactions with information, allowing users to continuously update, comment and explore the nodes and destination of the map. Moreover, another use of the maps is to chart the knowledge flows within a process, from the acquisition through development, storage, and internal and external deployment. The codification can then benefit from the use other tools such as a *thesaurus or dictionary* or a *Rhetorical method* (Conklin, 1996a). The latter is a conversational model for structuring the conversations occurring in technology. This method can provide a structure for discussing complex problems and can immediately improve the quality of the dialogue process. Moreover this system provides a basis for structuring the conversational record, and not only chronologically. Such a method can help in dealing with one of the main challenges of ICT for knowledge management: capturing tacit knowledge. According to Conklin (1996b) ICT can only partially capture tacit or informal knowledge. Some tools supporting this phase are *lessons learned,* documents containing experience on a specific project. However, even if in some companies this practice has become part of the standard operating procedure, it is very difficult to find instances of the resulting document actually being referenced in the next project. Another tool that can be considered, is groupware (Lotus Notes), but this is mainly a communication tool and so messages and documents created lack of structure, and the repository resulting is not a real database, making retrieving very difficult.

One important issue concerning knowledge storage, is knowledge maintenance: it is important to continuously review the usefulness of knowledge within the knowledge base, in terms of quality (timeliness, comprehensiveness, accuracy, cognitive authority), overtness (easy to allocate/access, incentives for usage & production, organisationally socialised and accepted), and relevance (level of demand, strategic importance, level of use in decision-making). The integrity of retained knowledge should be maintained by the system over time. It can be approached in two ways: firstly it has to deal with long-term storage, secondly, and more critically, it is how the system reacts to new knowledge and how it integrates this into the knowledge base (Croasdell, 1997; Stein and Zwass, 1995). This refers to mechanisms for long-term storage, methods for integrating old and new knowledge, and decision rules for selectively eliminating parts of memory (unlearning); for example eliminating older rules in favour of new ones. This problem becomes more critical as the size of memory becomes large (Conklin, 1996b).

Particular attention should be devoted to search and retrieval technologies. Stein and Zwass specify how a search is the process by which retained information is selected as relevant to a particular user or goal, retrieval is the reconstruction of the selected information to satisfy the user's request. Technologies have to provide means by which retained knowledge is brought to bear on a decision maker's problem context and user's goals. Thus it is necessary (Kolodner, 1984) that what is being sought must be described along with the context and user's goal; then the context and user's goal must be elaborated because they not necessarily meet the knowledge structure of the system, and then the query may be tackled interactively. Technologies for search and retrieval rely on pattern matching and recognition, knowledge of particular domain areas, limited natural language processing, knowledge of user goals and preferences, and the availability of alternative forms of knowledge representation. Examples include *retrieval of unstructured data* (text) or *semistructured data* (email messages) using *exact-match boolean logic*. Some more evolved systems use *fuzzy logic*, or rely on artificial intelligence using hybrid case and rule-based systems. Merlyn and Välikangas (1998) highlight how knowledge servers can completely change the perspective of retrieval. Knowledge servers are software systems that leverage the power of networked computing resources to deliver information to users in a more timely manner, and often from a greater number of sources than a human could access unaided. Their potential is translated in certain characteristics: they translate documents into the first language of the user, they can connect users with common interests, they can use context understanding to sort documents from a news aggregator into predefined categories, they can adapt answers to queries to the profile of the user and the context of the query itself, they can create highly specific user profiles, and they can access human experts if the electronic source fails. It is clear that, rather than a "pull" system, knowledge servers are examples of "push" systems and are based on push technologies (i.e. software agents) (Bradshaw et al. 1997).

Knowledge sharing and transfer

Firstly, it is important to note how knowledge sharing differs from knowledge transfer in terms of the direction of knowledge. Knowledge transfer implies a sender and receiver of knowledge (Bartezzaghi et al. 1997); knowledge sharing, on the other hand, requires that both the actors are senders and receivers at the same time. In order to foster knowledge sharing and transfer it is necessary to overcome some barriers: temporal distance in terms of historical barriers (separation in time) and current time (difficulty in coordination); physical distance/space, connected to dispersed environments; and social distance including hierarchical, functional and cultural differences (Bartezzaghi et al. 1997; Hendricks, 1999; Ruggles, 1997; Wijnhoven, 1999).

In order to overcome *temporal barriers*, certain technologies are suggested: for the historical barriers (separation in time) they can be referred to as codification and storage, as they imply the retention of knowledge; for the current ones (difficulty in coordination) there are internet-based forums (newsgroups) and groupware (Lotus Notes) (Ruggles, 1997; Hendricks, 1999). An interesting tool for fostering knowledge sharing, and overcoming temporal barriers, is case-based reasoning, that assists in extracting knowledge from past cases and applying it to the current situation.

To overcome *spatial barriers,* suggestions include war rooms (concerning specific projects) or talk rooms (concerning general topics)- these solutions could be real or virtual. Other tools concern simultaneous conversations, for example *Netmeeting*. In general, all groupware tools are focused on communication and coordination, and so they are not enough to build up a knowledge management system (Conklin, 1996a). In order to capture existing knowledge, it is necessary to "tap into" the existing flow of process interactions between the members and the organisation and to crystallise these as key elements of organisational memory.

Finally, to overcome social barriers as different frames and languages, a possible tool is based on learning maps.

For what concerns the question of how ICT can support clusters, the following description provides an overview of contributions specifically focused on applications of ICT to support the activities of the "Intra", "Group" and "Inter" clusters (an overview is shown in figure 2.16).

Cluster 'Intra': Regarding acquisition, Kalpic and Bernus (2001) emphasise the importance of *process modelling* as a tool that allows the creation of knowledge on enterprise processes. They present findings acquired in the reengineering of the process of new product development in an Australian company. Fowler (2000) focuses on *Artificial Intelligence* (AI) technologies and their potential applications in supporting KM activities. Such AI systems are expected to do things that have not been explicitly programmed, and to allow programs to mimic intelligence or learning. The potential and limitations of such techniques are typified in a real case of a "knowledge company" providing networking devices and services. Courtney (2001) underlines that *Decision Support Systems* (DSS) of organisations must embrace procedures that can deal with the complexity of the new economic context and go beyond the technical orientation of previous DSS. West and Hess (2002) describe a DSS, based on a Geographic Information System (GIS), showing how the design addresses specific KM problems. Bollojou et al. (2002) present an approach for integrating DSS and KMS in order to enhance the quality of support provided to decision makers. The integrated system facilitates knowledge conversions (as described by the traditional knowledge life-cycle model) through suitable automated techniques: it applies Knowledge Discovery Techniques (KDT) for knowledge externalisation, it employs repositories for storing externalised knowledge, and it extends KDT for supporting various types of knowledge conversions. Hendriks and Vriens (1999) propose *Knowledge Based Systems* (KBS) to formalise and automate knowledge. KBS are defined as the outcome of a knowledge modelling process that aims at capturing organisational knowledge in formal schemata to support decisional activities. O'Donnell and David (2000) propose a research framework for examining how features of an information system affect the decision-making process. Their discussion includes changes in the decision process initiated by implementing ERP systems, data warehouses, electronic commerce, virtual organisations, on line financial reporting and disaggregated financial statement information.

		Knowledge management phases		
		Knowledge acquisition	**Knowledge transfer**	**Knowledge capitalisation**
	Focus on description of functionalities	-links to internal and external data sources, information filtering, natural language processing, intelligent summarising capabilities -intelligent agents and search engines -knowledge charts and users profiles -associative list of words, concept maps -random through exercises	-Internet based forums, groupware -case based reasoning -war rooms and talk rooms -net meeting	-structures, temporal languages, models -scripts, frames, production rules, conceptual graphs -knowledge maps (contacts, documents, events) -thesaurus, dictionary -lessons learned -pattern matching recognition methods (fuzzy logic) -knowledge servers -push technologies
Clusters	**Cluster Intra**	-artificial intelligence -DSS -Geographical information system -knowledge discovery techniques	-artificial intelligence -integration between ERP and KMS -groupware and virtual communities -communication forums	-artificial intelligence -knowledge based schemata -document management systems -intelligent agents
	Cluster Group	-fuzzy group support -data warehousing	-communication tools	-knowledge maps -knowledge repository for shared documentation -data warehousing
	Cluster Inter	-ebusiness systems -data mining	-communication tools	-data warehousing

Figure 2.16: Literature Review on ICT Tools and KM

In terms of transfer, Walsham and Geoff (2001) analyse the benefits and limitations of computer-based systems for knowledge sharing within an enterprise by taking a human-centred view of knowledge. This approach emphasises the complex sense-reading and sense-giving processes, through which human beings communicate with each other. He suggests that any consideration of the role and value of computer based systems for KM should start with the human process involved rather than with the technology. Galliers et al. (2002) examine the simultaneous implementation within a single organisation of an *Enterprise Resource Planning* (ERP) and a KM system (KMS). Exploring their simultaneous deployment within an organisation allows the authors to examine the resulting interactions and impacts on efficiency and flexibility, suggested as incompatible in traditional organisational theory. Garavelli et al. (2002) analyse knowledge transfer using two main cognitive processes-codification and interpretation-and try to define the properties of knowledge technologies (in particular Intranet and Internet) to support such activities. Hayes and Walsham (2001) adopt a community of practice approach, considering the role of IT and in particular of groupware technologies in the knowledge work process. Hayes (2001) considers the opportunities and limitations that surrounded the use of groupware to support knowledge working both within and between temporal and spatial boundaries.

Some authors are rather critical of computer-mediated communication. Hayes and Walsham (2000) discuss how the political and normative context influences the nature of discussions and interactions in differing electronic communication forums. Newell et al. (2000) find that the introduction of communication forums reinforces the "powerful centrifugal forces operating at the strategic development of the firm" suggesting that this is prohibitive to knowledge working.

Turning to capitalisation, Zantout and Marir (1999) review the features of current document management systems with varying facilities to manage, store and retrieve either reference to documents or the complete documents. Intelligent information retrieval agents are presented as a way of shifting from pull technology, where the user has to actively initiate the request for information, towards push technology where available information is automatically delivered without user intervention.

Henriksen (2001) focuses on the problem of acquiring and disseminating knowledge when solving real problem.

Cluster 'Group': Regarding acquisition, Tiwana and Balasubramanian (2001) discuss a prototype of KMS that supports the knowledge creation process in the field of information product development in multinational teams. Lee and Kwok (2000) propose a fuzzy group support system for transferring scattered information into meaningful business knowledge that can support strategic corporate decision-making.

Considering knowledge transfer, Roberts (2000) reviews the ability of ICT to improve the transferability of knowledge. In particular, the author investigates the role of ICT in assisting the transfer of knowledge between internationally dispersed R&D units.

Turning to capitalisation, Gray (2000) proposes a KMS to help members of dispersed teams find individuals with the particular knowledge to support the analysis of complex problems. Gray proposes a knowledge map and a knowledge repository in order to store and retrieve knowledge in the form of documents, profiles, expertise, and competencies to support problem-solving teams. Mohrman et al. (2002) emphasise the role of IT in enabling virtual work because it allows communication across communities of knowledge composed of people working on different projects and in different business units.

Some authors provide contributions concerning more than one knowledge management phase. Nemati et al. (2002) propose, as an extension to the data warehouse model, a knowledge warehouse architecture that provides the decision-maker with an intelligent platform that enhances all phases of knowledge management at group level.

Cluster 'Inter': In considering creation and application, Wickramasinghe and Mills (2002) describe the experience of a healthcare delivery initiative aimed at enhancing and supporting the creation and renewal of knowledge among professionals (medics, physicians and so on) through an e-business system. Shaw et al. (2001) propose data mining and Knowledge Management Techniques to manage marketing knowledge and support marketing decisions. Increasingly, such knowledge is shared by an enterprise with its supply chain partners such as suppliers and retailers. Information Technology and the Internet have enabled and increased this sharing of knowledge. The authors report, as a classic example of this shared operation, the partnership between Procter & Gamble and Wal-Mart that uses concepts such as common data highway, joint scorecards and customer table checking, to share knowledge for mutual benefit of both partners.
In terms of transfer, Bolisani and Scarso (1999) examine the correlation between types of knowledge exchange and kinds of ICT applications through a number of case studies of various ICT applications implemented in the northeast of Italy in distinct industries (clothing, electro-mechanical components, footwear and motorbike). All the cases are characterised by the involvement of numerous interacting firms (especially small ones) and by intense knowledge flows. Parikh (2001) stresses that few R&D organisations in high tech industries have the know-how and ability to internally develop all the relevant technologies. Most of them take a mixture of approaches, including purchasing, licensing, partnering and outsourcing to build a portfolio of technologies. Building up such a portfolio requires aligning and coordinating R&D activities with strategic technology partners, and integrating knowledge inside and outside the firm through introducing the relevant supporting ICT tools. Johannessen et al. (2001) recognise the role of IT in transferring explicit knowledge and raise the problem of mismanagement of tacit knowledge. The purpose of their article is to improve the understanding of the role of tacit knowledge, and to reflect on and give guidance on how to handle the relationship between tacit knowledge and IT in inter organisational context.

2.7 SUMMARY AND CONCLUSIONS

The research interest of this thesis is on how knowledge processes can be supported in innovative and knowledge-intensive environments. The theoretical background underpinning this research subject comes from several streams of literature, and these have been reviewed concentrating on the issues that relate to the topic of this thesis. Several conclusions can be drawn from the overview provided in this chapter:

- The term "knowledge management" may be perceived as contradictory in itself. On one hand, knowledge is not a corporate resource; it belongs to individuals (Kim, 1993). On the other hand, the purpose of knowledge management is to enhance a firm's performance by designing, implementing, maintaining and improving a system (consisting of technological, organisational and managerial enablers) that supports the organisation's knowledge processes, i.e. the assimilation and generation, transfer and sharing, storage, exploitation and reuse of knowledge (Davenport et al. 1998). Thus, knowledge management is about creating an environment that encourages people to learn and share knowledge by aligning goals, integrating bits and pieces of information within and across organisational boundaries, and producing new knowledge that is usable and useful to the organisation. Systems supporting knowledge processes (and their management, for that matter) therefore exist in, and must be designed to fit, the internal and external context of the organisation.

- Knowledge management in this thesis is defined as follows:

  Knowledge management is the process of designing, implementing, maintaining and improving a system of organisational mechanisms, information and communication technologies and management systems (the levers) through which an organisation fosters and focuses individual and group behaviours in terms of assimilation and generation, transfer and sharing, capitalisation and reuse of knowledge, in both tacit and explicit forms that are useful to the organisation.

This definition underpins the key aspects of KM which rely on issues reviewed from the literature:

1) The definition of knowledge. Firstly, the concept of knowledge, which can be described in terms of six complementary characteristics: *knowledge is based on human belief* (Nonaka, 1993); knowledge is a *purposeful set of information* (Zack, 1998); knowledge is *dynamically accumulated over time* (Metcalfe and Gibbons, 1989; Dodgson, 1993; Penrose 1972, Wernerfelt, 1984; Rumelt, 1984; Barney, 1991; Peteraf, 1993; Collis e Montgomery, 1995); *knowledge circulates at the organisational level* (Kuhn, 1962; Dogdson, 1993; Wenger and Snyder, 2000); *knowledge can be shared in tacit or explicit forms (*Polanyi, 1966; Nonaka, 1993); *knowledge is created at the "boundaries of old" through an incremental process* (McKee, 1992; McDermott, 1993). These characteristics are related to contributions from organisational learning and innovation management. In particular, the perspectives of organisational learning (Section 2.3.1), the relation between individual and organisational learning and the concept of organisational memory (Section 2.3.3), the role of knowledge and learning in innovative contexts (Sections 2.3.2 and 2.4.2), the concept of knowledge as a source of competitive advantage (Section 2.5), and the classifications of knowledge (Section 2.6.1).

2) Knowledge management aims to stimulate knowledge processes. The definitions of knowledge management highlight the characterisation of knowledge processes in terms of phases: assimilation and generation (acquisition of knowledge), capitalisation and reuse, and transfer and sharing of knowledge (Section 2.6.2).

3) Knowledge management is a configuration of technical, organisational and managerial choices. As described in Section 2.6.3, literature provides several levers to stimulate knowledge processes. These can be classified according to the phase of the knowledge process, and the dispersion of the actors they address.

4) Knowledge management directly influences human behaviour, and hence company performance. In literature, the behavioural and cognitive approaches to learning and knowledge processes have been discussed (Section 2.3.1).

CHAPTER THREE:
THE CONTRIBUTION OF PRELIMINARY RESEARCH WORKS

3.1 INTRODUCTION

This chapter aims to highlight the contribution of the CIMA project, and further research work related to CIMA, to the development of this thesis. In more detail:

- The CIMA project (ESPRIT 26056). One of the aims of the CIMA (Continuous Improvement for global innovation MAnagement) project was to develop a methodology to support companies in managing learning and continuous improvement (CI) in Product Innovation (PI) Processes. The CIMA project pursued the specific objective of developing, testing and disseminating a methodology to support Product Innovation knowledge transfer within and among firms.
- Gieskes' PhD thesis (2001) which aimed at refining results from the CIMA project with regard to variables and their relationships within the model of Learning and Continuous Improvement in Product Innovation.

The relationship between the present work, theoretical background (Chapter 2), the CIMA work and Gieskes (2001) is represented in figure 3.1.

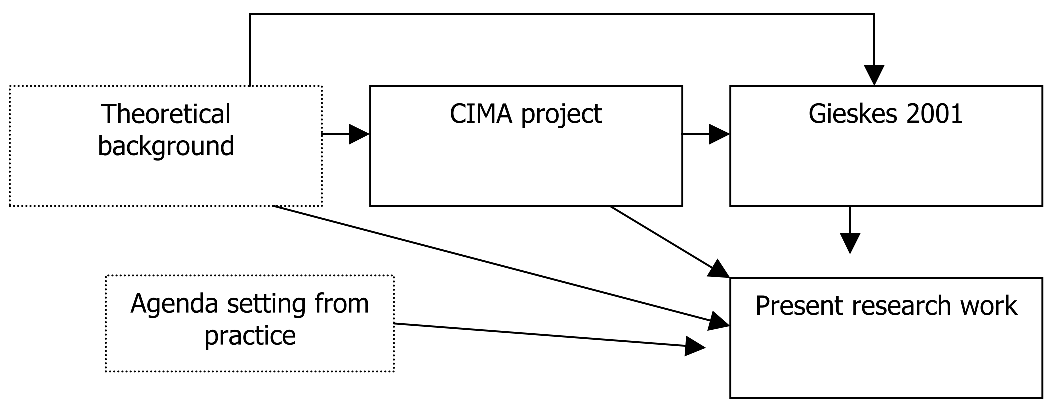


Figure 3.1: The relationship between CIMA related work and the present thesis

This chapter aims to assess the contributions from previous research (CIMA project and Gieskes, 2001) in terms of:

- Research results: the two pieces of research aimed at developing and refining a model for learning and continuous improvement in product innovation processes. Although this thesis is focused on the knowledge (management) process, the results referred to in this chapter can be considered as a starting point. Then, in Chapter 4, the contribution of this research will be highlighted.
- Research setting: the focus of the two research contributions is on Product Innovation. This thesis will not specifically address product innovation issues, but rather innovative environments. Innovation is therefore, to a certain extent, common to both the present and the previous research.

- Investigation framework: in the CIMA project, an investigation framework and research protocol have been developed that are extremely useful in developing the investigation framework in this thesis.
- Literature: for this thesis, specific streams of literature have been analysed (i.e. organisational learning, innovation management, ICT management and knowledge management). Nevertheless, literature, especially concerning organisational learning and continuous improvement, has been also analysed during previous research works.

The main goal of this chapter is so to provide a limited review of the contents and results of the CIMA project and Gieskes' thesis in order to clarify their contributions to KM issues, and then to move on to the research questions addressed in this thesis. Section 3.2 briefly describes the main phases of development of the CIMA project, with particular attention to the explorative research part. Then the following section (3.3) will be dedicated to analysing the contribution of CIMA to the present research in terms of the developed framework. Finally, Section 3.4 addresses the Gieskes' PhD thesis results. This chapter focuses on the description of the major results coming from preliminary research work, while in Chapter 4 they will be discussed in relation to the research questions of this thesis.

3.2 THE CIMA PROJECT

The CIMA project's overall aim was to develop, test and disseminate a framework, called the CIMA methodology9, to assist companies in stimulating the process of Continuous Improvement (CI) in Product Innovation (PI), by facilitating knowledge transfer in a global context. In more detail the research objectives were formulated as follows (original phrasing in the research proposal, 1997):

- Describe how companies stimulate a process of continuous improvement of their product innovation capabilities by facilitating a diffuse and continuous flow of knowledge both within their organisational boundaries and with other organisations.
- Explain this process in terms of specific barriers and enablers to CI of product innovation capabilities.
- Identify contingencies which drive the choice of specific enablers, with particular reference to companies competing in global environments.
- Explore the effects of different choices in terms of performance and capabilities.
- Suggest companies actions to foster CI and knowledge transfer in product innovation processes coherently with their specific objectives and characteristics;
- Derive implications for actions at the regulatory and infrastructural levels, to enhance co-operation between Europe and Australia.

The project involved universities and research centres in Europe and Australia. MIP Politecnico di Milano was the main contractor of the project, in charge of managing the project, leading the cooperation centre set up (in collaboration with some subcontractors), and coordinating the work of the trial project together with the research partners. Moreover, MIP played a central role in the development of the investigation framework

9 In CIMA terms a methodology is a system of methods and principles for researching learning in product innovation processes. The model represents the way learning in product innovation is viewed and such it forms the core of the methodology.

and preliminary case studies. The other research partners of the project were the University of Twente, leading the in-depth case studies activity; CENTRIM, University of Brighton, was in charge of the development the CIMA research methodology; Trinity College of Dublin, especially for specific competence in product innovation and learning topics; CORE, Chalmers University, managing the application of the methodology. Australian partners were InCITe (University of Western Sidney Macarthur) and Monash University in Melbourne who paralleled the same research in Australia.

In order to develop the CIMA methodology, several activities were carried out, as represented in figure 3.2 (see also Boer et al., 2001). Two main phases particularly characterise the project: the explorative phase which, starting from literature review[10], has developed ten in-depth case studies in order to provide a common framework on learning and CI in product innovation (Corso and Pavesi, 1998). Relevant activities in this phase concerned the development of a preliminary framework based on the literature review, the formalisation of an investigation framework, including a questionnaire and investigation protocol, the development of a pilot case to test the usability of the investigation framework for all the researchers involved (CIMA deliverable D9), and finally the analysis of results and data collected. The second phase, research through intervention, concerned the development, application (through action research, workshop and remote use modes), refinement and testing of the CIMA methodology (CIMA deliverables D12 and D13; Boer et al 2001), relying on the CIMA model. Data coming from this part of the research, which were stored in the CIMA database, were used by Gieskes in order to further refine the model (Section 3.4).

Two outputs of the CIMA project are therefore important inputs for this research thesis:

1. The CIMA model that was developed starting from the literature review and through the explorative research. It has been the engine of the CIMA methodology (Section 3.3);
2. The data and preliminary results coming from the application of the CIMA methodology, which have been further elaborated and extended (Section 3.4).

10 The results of CIMA literature study are published in CIMA WP 2.2.

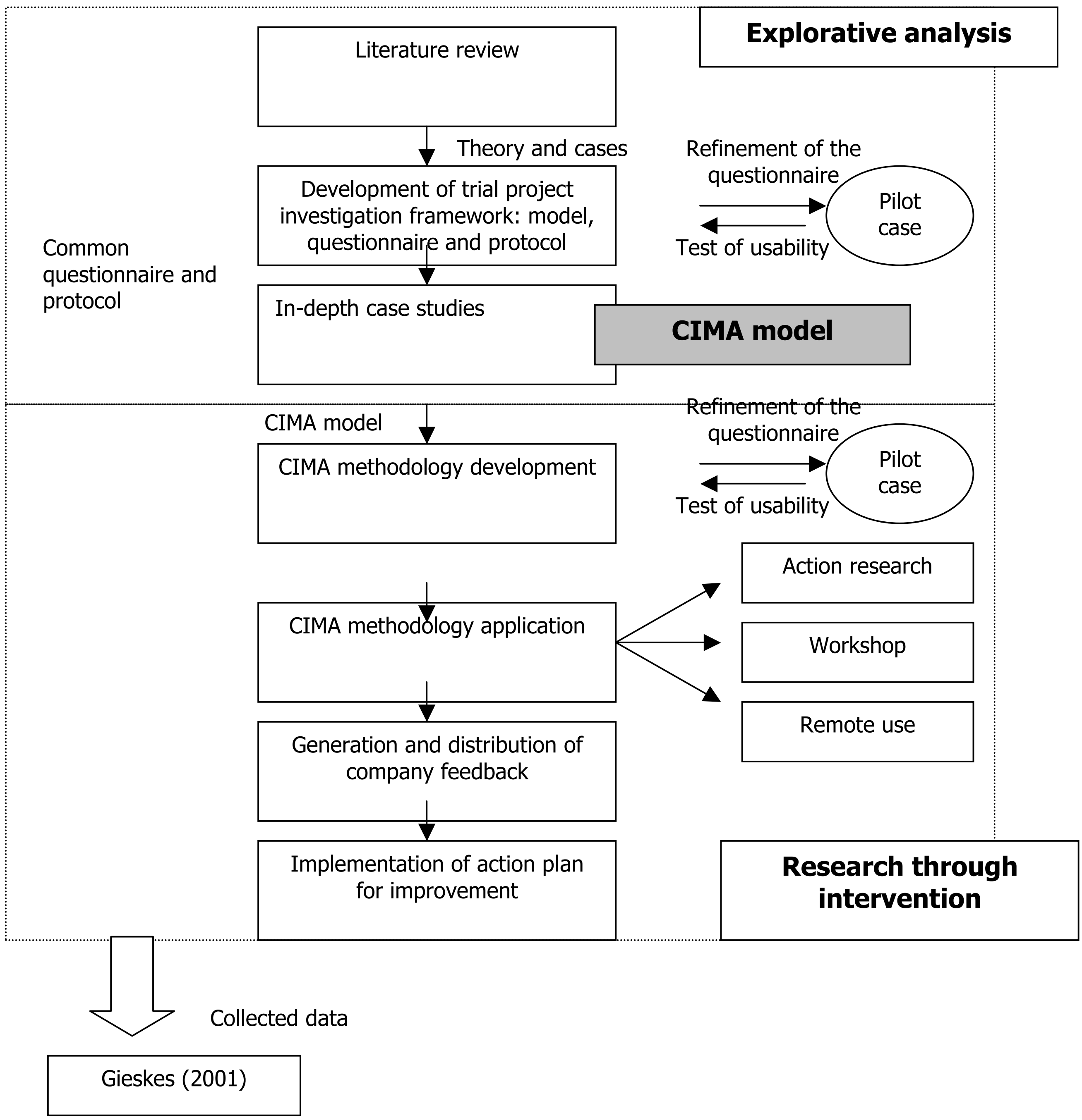


Figure 3.2: Activities of the CIMA trial project

3.3 THE DEVELOPMENT OF CIMA MODEL: APPROACH AND RESULTS

The CIMA model describes how *learning and continuous improvement take place in product innovation process.* The CIMA project is focused on the Product Innovation (PI) process, described in process terms, where information and materials are transformed and incorporated into samples, prototypes and products. Moreover, the "*overall process of product innovation*" (figure 3.3) for each product (A, B, and C) overcomes the traditional boundaries of the product development process (concept, product and process design, product launch), by including phases belonging to the product life cycle which are supposed to be involved in knowledge flows over time (improvements in manufacturing, enhancement and upgrading during use, and customisation and sales installation).

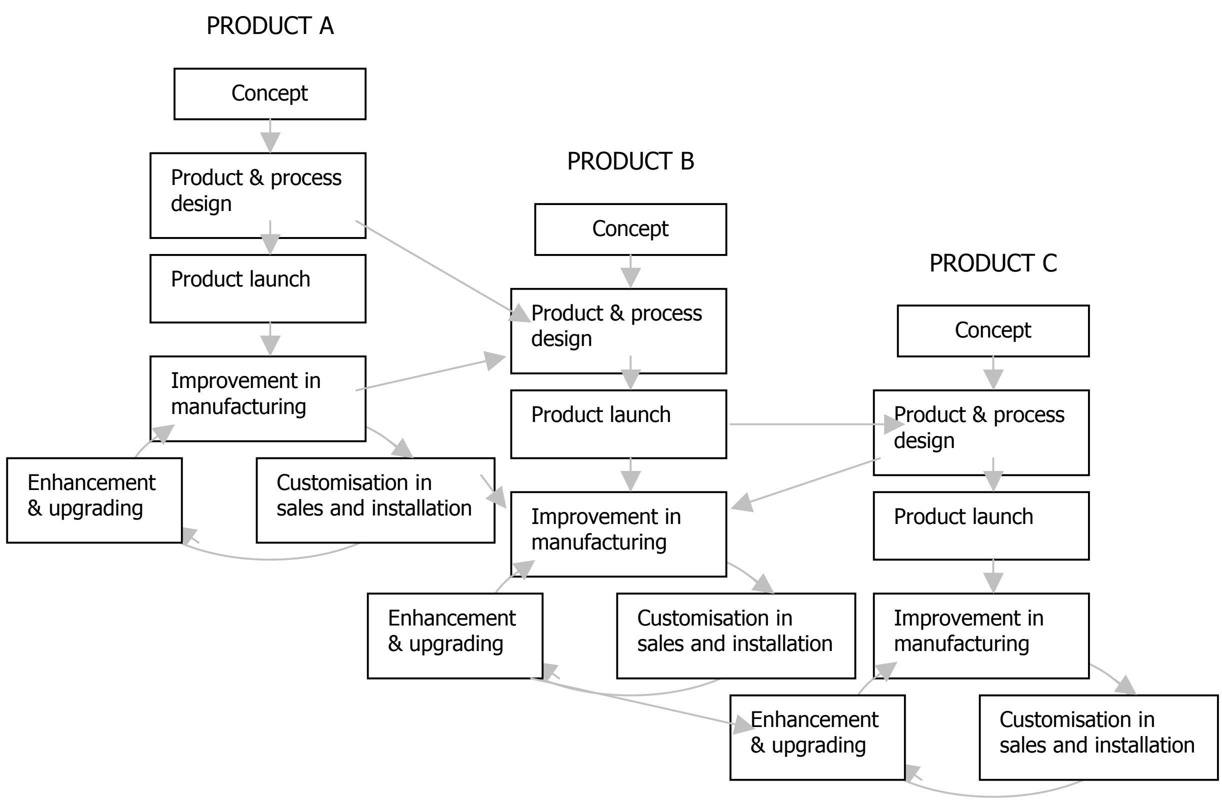


Figure 3.3: The PI process analysed in the CIMA project (Bartezzaghi et al, 1998, p.80)

Each of the indicated phases of PI process can be developed inside the company or in collaboration with other partners so the analysis has to take into account variables concerning both *intra-and interfirm relationships*.

Moreover, the CIMA model is focused on the analysis of *incremental improvements* in the development of products and processes, which take place due to experiences collected in different parts of the PI process. As it is called in literature, Continuous improvement (CI) is: "...an organisation-wide process of focused and sustained incremental innovation" (Bessant & Caffyn, 1997). Given the characteristics of product innovation projects, that are not repetitive processes, improvements are mainly possible in an *inter-project perspective*. The specific object of the investigation within the company is therefore a product family, that is, a sequence of related projects having strong mutual interdependencies (product A, product B and product C in figure

3.3). Given this perspective, it should be noticed that a first object of an investigation concerns the definition itself of what a product family is within the investigated company, which reflects its strategy in creating and managing interdependencies between products. Relationships could concern market, product-or process-technologies, or the product life cycle, so leading to different definitions of product families.

Finally, the CIMA project is focused on the process of *learning* in product innovation which, in this project, is considered to be the process of acquisition, transfer and sharing, capitalisation and reuse of knowledge (Bartezzaghi et al., 1997; Huber, 1991).

The CIMA model has been developed from preliminary theory and a set of ten in-depth case studies, and is represented in figure 3.4. This model describes the learning process within product innovation in terms of a number of interrelated variables: performances, behaviours underpinning continuous improvement and learning within product innovation, levers that can foster these behaviours, company contingencies and capabilities. In particular, through the in-depth case studies, an investigation and the operationalisation of such variables is achieved (Corso and Pavesi, 1998).

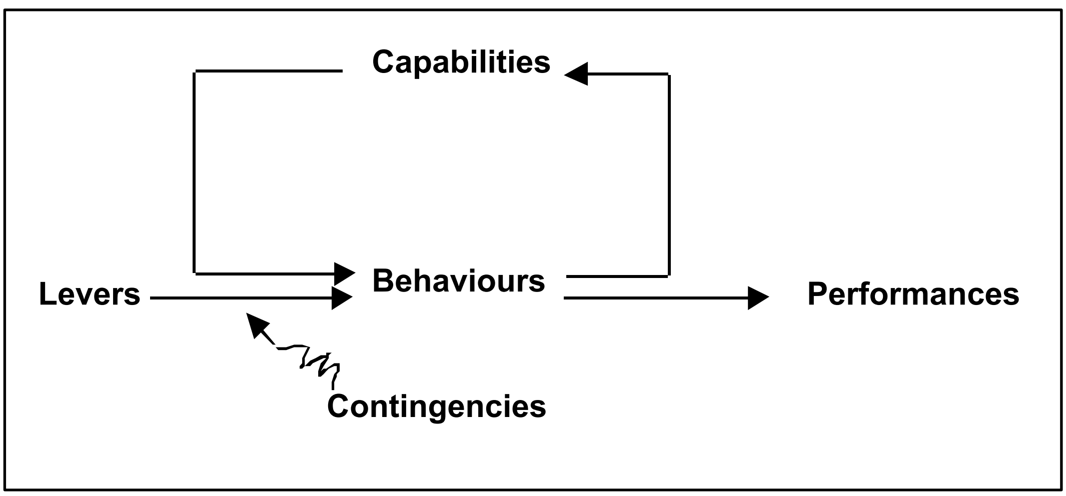


Figure 3.4: Basic model underpinning the CIMA methodology

In order to understand how learning takes place in product innovation and can be fostered in organisations, the CIMA project firstly resorted to a set of ten exploratory studies. The exploratory sample was selected without any attempt made to be fully representative of the current situation in the market. Companies were rather selected for their interest and recent attempts to improve product innovation leveraging on their learning and knowledge management practices. The objective was therefore to increase the chance of including "good" practices in different contexts in the analysis and comparison. Each company involved in a case study was analysed over about four days through interviews with people playing key roles in the PI process. In particular, CEOs (division managers), R&D managers, designers and key representatives from marketing, manufacturing, purchasing and quality were involved through individual or group interviews, using questionnaires agreed at international level. Coherent with the inductive research approach, the unit of analysis was an existing family of products: questions were always aimed at recording concrete "facts" rather than "should be" situations. In particular, emphasis was on discussing histories of improvements and knowledge transfer between projects over time, and understanding enablers and effects at the organisational level. The explorative peculiarity of the research has driven the design of the questionnaire: it consisted of questions with specific prompts in order to facilitate the interviewed person, while at the same time facilitated the common interpretation of the question within the research team. Moreover, the development of case studies and, at the same time, the organisation of frequent meetings within the consortium facilitated the refinement of the model.

According to the case studies, the effectiveness of an organisation in stimulating and sustaining learning can be expressed through *improvement performances*. These result from *behaviours*, which are the combination, at the organisational level, of behaviours of individuals and groups concerning knowledge acquisition, transfer and sharing, capitalisation and reuse. Management can foster and sustain behaviours through actions and decisions which we refer to as *levers*. The actual effectiveness of levers in producing the desired behaviours depends on *capabilities* that reflect the organisation's maturity in practising the values of a learning organisation. Referring to literature on the resource-based view (Penrose, 1959; Collis and Montgomery, 1995), capabilities can be thought of as integrated stocks of resources that consist of internalised behaviours, technical skills, organisational routines and corporate assets (e.g. Information Systems, databases, libraries, tools, handbooks). Depending on their nature, resources can be established through deliberate decisions or accumulated over time through the practice of learning. When integrated and consolidated over time, these resources become embedded in the organisation and do not require further efforts by the organisation.

Through the development of in-depth case studies, the variables in the model have been investigated and classified. The main variables and their operationalisation, resulting from the case studies, are summarised in figure 3.5.

Performances

Three types of performances are distinguished in the CIMA research: improvement performances, people performances and process performances.

Improvement performances (P1), can be addressed as:

- *Improvements generation* measures the extent to which individuals and groups in an organisation propose improvements. Besides being related to creativity and the quality of human resources, a good performance shows the presence of an underlying culture that promotes experimentation and learning.
- *Improvements coherence with corporate goals* measures the degree to which improvements are coherent with each other and follow the priorities expressed by corporate goals. A good performance is a sign of good management and communication, and of widespread commitment to organisational strategies.
- *Improvements diffusion within the same PI process within and across organisational boundaries* measures the effectiveness of the organisation in disseminating knowledge among individuals and groups within the same PI process in order to stimulate learning and the generation of new ideas; exploiting synergy both within the firm and with other partner organisations.

- *Improvements diffusion among different PI processes within and across organisational boundaries* measures the effectiveness of the organisation in disseminating knowledge among individuals and groups within different PI processes in order to stimulate learning and generation of new ideas, exploiting synergy both within the firm and with other partner organisations.
- *Improvements consolidation* measures how well the organisation can appropriate knowledge from individuals and embed it in the corporate assets that can be more widely disseminated.

Although the direct effect of behaviours is related to improvement performances (which have been listed), from the case studies it has been observed that learning also improves the quality of working life and the level of satisfaction in work, which have been addressed as *people performances (P2)*. Indirect effects of learning result also on *process performance (P3).* These performances have been measured in case studies comparing two different projects: one a recent project and the other a project concluded earlier.

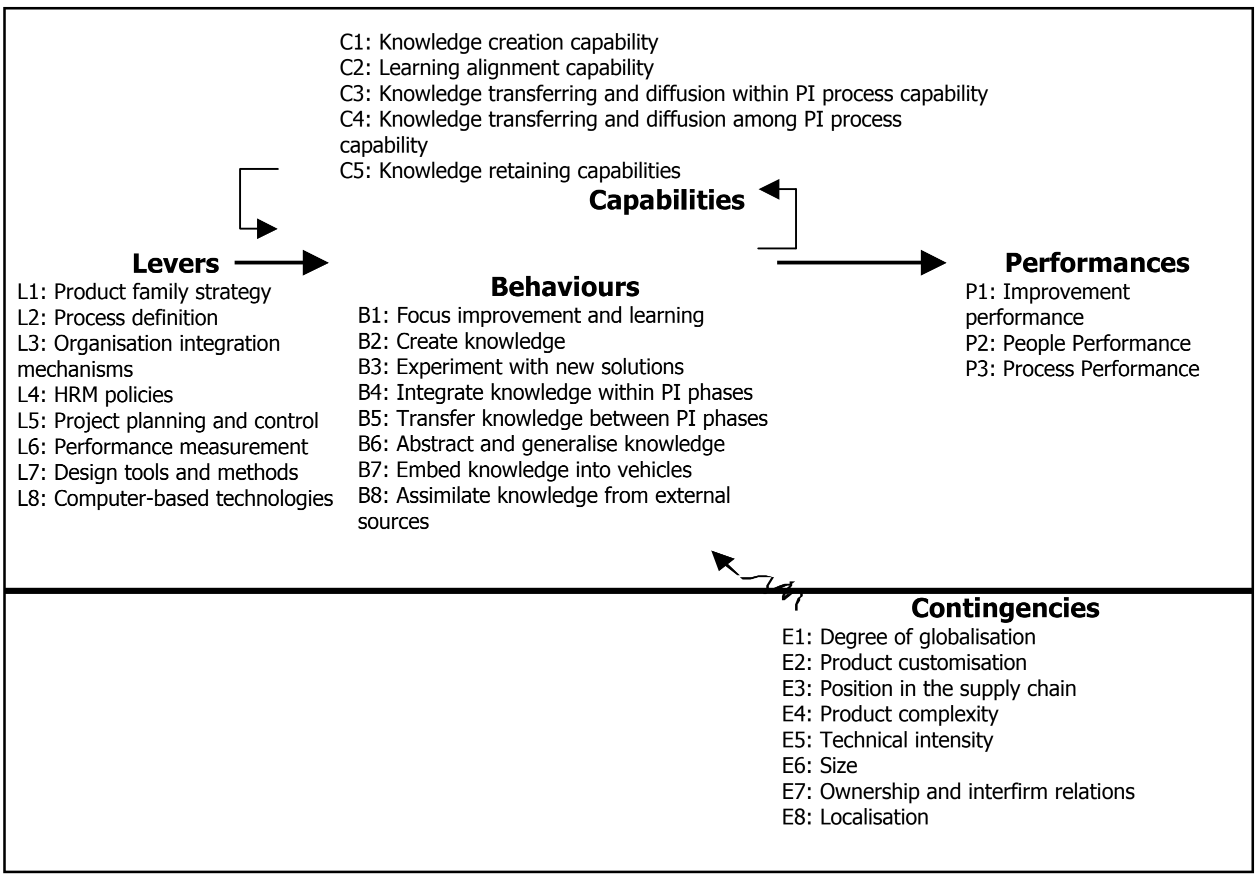


Figure 3.5: The operationalisation of the CIMA model

Behaviours

Evidence from the exploratory studies suggests that a high level of performances derives from the combination of behaviours of operatives and managers that can be grouped into eight main classes:

B1. *Individuals and groups use the organisation's strategic goals and objectives to focus and prioritise their improvement and learning activities*. This is the combination of behaviours of both operatives and managers that results in people selecting learning goals according to the organisation's priorities. Management plays a crucial role in deploying corporate strategy, translating it into concrete improvement needs to which human resources can be committed. If people throughout the organisation exhibit this behaviour, the improvements generated are coherent with corporate goals (P2).

B2. *Individuals and groups use innovation processes as opportunities to develop knowledge*. People consider experimentation and learning as a natural part of each product innovation process. Failures are not condemned but regarded as experiences that can provide useful knowledge for future innovation activities. In planning and managing innovation projects, management pays close attention to balancing short-term objectives with the need for developing and diffusing knowledge for the overall organisation. In such a way, two main goals are reached: the number of improvements generated (P1) is higher, and their coherence with corporate goals is fostered (P2).

B3. *Individuals use part of available time/resources to experiment new solutions*. People have slack resources at their disposal, in terms of time and/or budget, that can be devoted to activities that are explicitly aimed at developing knowledge or testing new solutions. Managers generally leave people a large degree of freedom in deciding how to use these spare resources to pursue innovations to which they feel personally committed, so that improvement generation is enhanced (P1).

B4. *Individuals integrate knowledge among all different phases of Product Innovation.* Perceiving that all the different phases of the CPI process as strictly related, people transfer and retrieve information from one phase to the other. Overcoming organisational, space, and time barriers that emerge in this transfer, calls for an aware approach towards knowledge transfer and integration at managerial and organisational level. If this behaviour is diffused and frequent, improvements are more diffused and knowledge is transferred and disseminated within the same PI process (P3), within the firm and with partner organisations.

B5. *Individuals transfer knowledge among different Product Innovation processes*. Being aware of the importance of sharing knowledge acquired in different PI processes, and perceiving it as something that the organisation appreciates and recognises, people make explicit, and communicate, their experiences. Similarly, when coping with a new problem, people consciously look for previous experience that can be somehow useful. So knowledge will be more effectively disseminated and improvements diffused between different PI processes (P4) and then consolidated (P5).

B6. *Individuals abstract knowledge from experience, and generalise it for application on new processes*. Analysing experience, people try to produce knowledge and information that is really important and can be applied to other situations. In such a way improvements are consolidated (P5) and acquired knowledge can be retrieved.

B7. *Individuals embed knowledge in vehicles*. People systematically embed knowledge in vehicles such as people, reports, databases, product and process standards that can be more promptly disseminated and retained over time. Therefore, if B7 is effective, the consolidation of improvements (P5) is easier.

B8. *People assimilate and internalise knowledge from external sources.* People are aware that external actors (competitors, universities, research centres, etc.), though not directly involved in the PI process, can be valuable sources of knowledge that can be usefully combined with internal ones. By exploiting knowledge from external actors, improvements can be more easily generated (P1).

Each behaviour has been mapped according to two dimensions: the frequency with which the behaviour is shown, and the diffusion of the behaviour throughout the product innovation process. They have been measured on a five-point Likert scale ranging from non-existent to engrained behaviour (i.e.the behaviour is always shown and shown throughout the organisation).

Levers

Management can encourage certain behaviours by the implementation of levers, which can be grouped as follows:

L1. *Product family strategy* includes all decisions aimed at planning, deploying and communicating, corporate policies, priorities and plans concerning product innovation. Within this class, particularly policy deployment, product family plans, carry over policies, shelf innovation and standardisation policies, demonstrate relevant effects in orienting people's attitude towards experimentation and innovation.

Although often disregarded in practice, the role that policy deployment can play in aligning improvement efforts with corporate priorities is widely recognised (Corso et al, 1996; Uzumeri and Sanderson, 1995). Proactive planning of product families is also increasingly used: by defining new product contents in terms of similarities and differences from existing products, one company can plan a new product's expected degree of innovation and the relationships with past experience. In particular, in developing and managing product platforms, companies can embody, transfer and refine knowledge: if adequately managed and used, these sets of standard design solutions become vehicles of architectural knowledge effectively embodying and transferring experience from one product to another within a product family. The definition of component standards and shelf innovation policies sets clear directions and constraints to innovation and carry over of existing knowledge. In our explorative studies, the use of policy deployment, product platforms and component standardisation proved to foster behaviours of *knowledge transfer among different processes (B5)*, *knowledge abstraction and generalisation (B6)* and *embedding knowledge into vehicles (B7*). Product family strategies and policy deployment also facilitate behaviours in terms of *finding learning opportunities in daily activities (B2)* and *allocating resources to learning (B3).*

L2. *Innovation Process Definition* includes all actions that are aimed at defining and standardising the broad sequence of phases and tollgates of the Product Innovation process. Process definition strongly influences procedures and patterns of knowledge transfer, and therefore opportunities for learning. The identification of the main activities, the internal and external actors involved and consulted during each phase, the specific responsibilities and definition of overlaps or «gates» between phases, strongly affect learning behaviours throughout the organisation. In the explorative studies we found most companies resorting to standard, and often certified processes, in the attempt to foster *integration within and between different phases of the PI process (B4*) especially by providing clear references and enforcing the use of formal reports.

L3. *Organisation integration mechanisms* concern the use of organisation to garrison the accumulation and continuous improvement of knowledge over time. In particular the design of adequate organisational units, lateral structures (temporary teams or committees), co-ordination and integration roles and mechanisms, and team working practices can help individuals to transfer and recombine knowledge. Some of the companies involved in the exploratory studies, for instance, decided to shift from a traditional functional organisation to a matrix where the line management remains responsible for the development of specialised competencies and human resource management, while the responsibility for project performance and development of architectural knowledge is given to cross-disciplinary units.

In other cases, companies simply rely on the use of temporary organisational structures, such as teams or committees, or on integration roles and meetings, to facilitate the communication and accumulation of multidisciplinary knowledge. In terms of specific behaviours, most companies claim relevant effects of this lever on how people *transfer knowledge inside (B4)* and *between (B5) PI processes* and on *assimilation of knowledge from external sources (B8).* Integration roles, moreover, can have positive effects on the use of an organisation's strategic goals to *focus improvement (B1)* and on the use of innovation processes as *opportunities to develop knowledge (B2)*. Finally, team-working activities can foster *abstraction* and *generalisation knowledge (B6)* and *its translation into vehicles (B8)*.

L4. *Human resources management policies*. Most human resources management policies can, if adequately oriented, stimulate and orientate learning (Daft, 2001). This is, as a matter of fact, the main objective of training programmes, but also reward systems, job rotation and empowerment programmes can have non-trivial effects on the nature of competencies people accumulate. While the use of personnel rotation and inter-departmental career paths may, for instance, improve cross-fertilisation among different organisational units and facilitate the development of architectural knowledge, formal departmental assessment and development plans generally foster and develop specialist skills within each unit.

In terms of behaviours, the use of human resources management policies based on incentives and reward systems is generally aimed at *fostering commitment to improvement (B3)*, at *directing efforts coherently to corporate goals (B1)* and at *assimilating knowledge from external sources (B8)*. Job rotation policies, finally, are often used to foster *knowledge transfer inside (B4*) and *between (B5) projects*.

L5. *Project planning and control*. Mechanisms such as scheduling, budgeting, resource allocation and responsibilities definition, milestones setting and design reviews are primarily aimed at fostering co-ordination within each project. Their use, however, can have a strong influence on how people learn and transfer knowledge not only *within* (B4), but also *between* (B5), projects. The use of formal project termination reports and close out meetings, for instance, can stimulate critical analysis of feedback and make lessons learnt explicit (B6). Also during project executions, design reviews can help the diagnosis of problems and the transfer of solutions. An interesting approach was found in one company in the sample: in order to enhance effectiveness of Design Review meetings, people from other projects were invited to discuss the problems that emerged.

In the sample, project planning and control systems, are also used to *foster commitment to improvement (B3*), *coherence to corporate goals (B1),* analysis of feedback *and knowledge abstraction (B6*), and *embedding of knowledge (B7)* in vehicles.

L6. *Performance measurement*. In manufacturing environments, the use of formal *performance measurement* (L6) systems to stimulate improvement and learning in Product Innovation is not straightforward from either a conceptual or a practical point of view. When dealing with not-repetitive processes, measuring and comparing performance is even much more difficult, and an inappropriate measurement system can inhibit experimentation, with a detrimental effect on innovation.

Notwithstanding these conceptual difficulties, most of the firms systematically analysed measures such as time to market and defectiveness comparing them with previous results, with other subsidiaries, or with leading organisations, using more-or-less formal benchmarking activities. Some companies also tried to measure creativity through indicators such as the number of opportunities for improvement proposed in each unit.

By providing people with valuable feedback, performance measurement systems can foster *commitment (B3)* and *coherence (B1)* of improvement activities. Moreover, performance measurement plays an important role in *stimulating knowledge abstraction (B6), transfer among processes (B5)* and *assimilating knowledge from external sources (B8).*

L7. *Design tools and methods*. This lever, in product innovation, while enhancing effectiveness of design activities, can provide additional vehicles that embody knowledge thus fostering learning and knowledge transfer throughout an organisation. Examples are the use of problem solving tools (as Seven Quality Tools), standardised design methodologies and procedures, libraries of standard design solutions, integration procedures (MRP, QFD, DFM, DFE, LCA, FMEA…), prototyping and testing methods.

These process standards can be implemented according to different approaches and with different objectives. For example, some companies use process standards to co-ordinate and impose efficient work practices, while others try to stimulate understanding and continuous improvement of the organisation's best practices. So, from this perspective, standards are not perceived as rules that could inhibit experimentation and innovation, but rather as dynamic tools that can be constantly discussed and enhanced.

The use of standard methods is often facilitated by the use of organisational mechanisms (e.g. process teams, quality forums).

Design tools and methods, and in particular analysis and diffusion of best practices, are used to *foster knowledge abstraction (B6) and embodiment (B7).* Moreover, design tools and methods can stimulate *commitment (B3) to improvement activities,* and their *coherence to strategic goals (B1).*

L8. *Computer-based technologies*. These levers mainly concern the use of ICT to foster learning and knowledge transfer in PI. Examples could be IT systems (e.g. Netware, PDM), Computer Aided Technologies (CAD, CAM, CAE, CAPP, virtual design simulation), or technologies for prototyping and pilot production. The role of ICT is clearly important as it greatly contributes to the quality and flexibility of communication channels and to information-processing capacity. This is not only true for large, geographically dispersed, organisations; it is becoming increasingly important for small companies that have to rely on sources of competitiveness outside their borders. Examples include the use of ICT to create a virtual co-location by connecting geographically dispersed departments, and the transfer and reuse over time of design solutions exploiting the opportunities of integrated Product Data management and three-dimensional CAD.

Capabilities

Evidence from the exploratory studies, as well as literature, suggests that a lever's effectiveness depends on a company's capabilities, and that these can be grouped into five main classes:

C1. *Knowledge generation capability*. This is a set of organisational routines, shared values, and consolidated behaviours that create an underlying culture promoting experimentation and learning. This capability is particularly important if the organisation tries to foster behaviours such as assimilating knowledge from external sources (B8), experimenting new solutions (B3), and using innovation processes as opportunities to develop knowledge (B2), through enablers such as organisation integration mechanisms (L3) and human resources management policies (L4). The case studies showed that the impact of these levers on behaviours strongly depended on the level of consolidation of C1.

C2. *Learning alignment capability*. This is a set of organisational routines, shared values, and management tools that allow the organisation to create motivation towards meeting corporate improvement goals. If this capability is present within the organisation, almost all the managerial levers in the model can help people use strategic goals to prioritise improvement activities (B1).

C3. *Knowledge integration within PI process capability*. This is a set of behaviours, values, assets and tools facilitating the transfer of knowledge inside and across organisational boundaries. For instance, in the case studies analysed, some organisations design the PI process (L2), define integration roles (L3), encourage team working (L4) and strong communication even through ICT tools (L8), in order to foster integration within the PI process, thus enhancing knowledge transfer. However, the effectiveness of the implementation of such managerial levers strongly depends on the maturity of the organisation in terms of knowledge integration capability.

C4. *Knowledge transferring and diffusion among PI processes capability* consists of a set of behaviours, values, assets and tools that facilitate the transfer of knowledge inside and across organisational boundaries. As with C3, companies try to implement managerial levers such as integration mechanisms (L3), human resources management policies (L4), performance measurement (L6) and ICT tools (L8), in order to stimulate the transfer and retrieval of knowledge to and from other innovation processes. The effects are strongly related to the maturity of the organisation, and to the consolidation of practices concerning transferring and diffusion between PI processes.

C5. *Knowledge consolidation capability* is a set of behaviours, routines, assets and tools that facilitate the embodiment of knowledge into organisational assets. Therefore it is the capability to consolidate knowledge (internalising or articulating it) and translate it into normal practices. For instance, in some organisations, the use of product strategy policies (L1), or process standards as procedures (L7), can encourage people to abstract and generalise knowledge (B6), and then embed it into vehicles (B7). The effectiveness of such a policy strongly depends on C5.

Overall, the capabilities refer to knowledge creation (C1, C2), transfer (C3, C4), storage, reuse and application (C5). They are at the organisational level, and they derive from the consolidation of behaviours which are repeated over time thus becoming more and more natural. Moreover, it can be noticed that there is a two-way relationship among capabilities and performance. Each capability represents the potential of the organisation to effectively produce the corresponding performance when decisions are taken to stimulate an adequate set of behaviours.

The capabilities were not operationalised any further, and were not included in the investigation questionnaire for the second step of the CIMA research. The information retrieved from the case studies and from literature research resulted in lengthy discussions within the CIMA consortium on the operationalisation of the categories. It was concluded that it was not possible, within the framework of the project, to operationalise the capabilities and test their validity.

Contingencies

Finally, the way in which the PI process actual unfolds and progresses, and the design and functioning of its organisation, are dependent on many other factors, which are exogenous to the model, but can condition the relationships among variables. In the model in figure 3.5, these variables are called contingencies, which can be both external and internal to the company. The former are related to the environment within which the company is operating (e.g. Environment turbulence, Localisation); the latter are related to a company's characteristics (e.g. Size, Product Customisation). It should be noted that the impact of variables in either set could be within the company or on its environment (i.e. considering the influence of national culture: the variable is external to the company, but its impact is inside the company's operations as it acts on people). In more detail, the contingency variables identified in the CIMA research are:

E1: *Degree of globalisation* representing to what extent the market, the NPD activities and the operations of the companies are dispersed.

E2: *Product customisation* representing the level of standardisation of the developed product. In particular it indicates if the product is standardised, is modularised (i.e. based on a number of standard components assembled to match a customer's order), is based on a product platform (which it shares with a number of other products, but at the same time containing a significant number of product-specific parts), or if it is to some extent customised and receives unique characteristics depending on the customer's order.

E3: *Position in the supply chain* describing the number and type of suppliers and customers of the company, and therefore the complexity of the relationships it has to manage.

E4: *Product complexity*. Product complexity can be represented in terms of internal product complexity (which describes how complex the internal structure of the products is, in terms of the number of parts and components), external complexity (in terms of complexity of the user interface as a product can be characterised by very high specificity of performance criteria), and technical complexity (in terms of number of technologies included in the product and dissimilarity among them).

E5: *Technical intensity.* Representing the percentage of the company’s white-collar staff involved with technical issues.

E6: *Size* of the company, in terms of number of employees and turnover.

E7: *Ownership and interfirm relationships.* The ownership of a company reflects whether it is a privately owned business, an independent public company, a part of a small or large company group, or a subsidiary of a multinational corporation. It is also related to the type of interfirm relationships that the company relies upon. A company could handle everything internally except for pure marketing, distribution agencies, etc. On the other hand, a company could rely heavily on many interfirm relationships, including technology joint ventures, R&D partnerships and other strategic alliances.

E8: *Localisation*. The localisation of a company in specific countries is related to the possibility of accessing knowledge developed at universities and research centres, and to the labour turnover (churn), which is higher in some countries than in others. Moreover, it is also related to cultural characteristics such as national culture, uncertainty avoidance, and collectivism (Hofstede, 1980).

3.4 THE REFINEMENT OF THE CIMA MODEL

Starting from the framework in the previous section, 70 companies in Europe and Australia have been involved in the second part of the CIMA project, and results of the investigations have been stored in a computerised database. The data have been collected according to three approaches: action research, workshops, and remote use of the questionnaire; and these have been discussed in terms of challenges, and limits, of the results obtained (CIMA deliverable D13).

Using the collected data, the main goal of Gieskes (2001) was to refine the preliminary model from the CIMA project, represented in figure 3.5, in terms of 1) analysing which levers have a stimulating effect on learning behaviours in product innovation processes; 2) analysing which disablers or barriers to learning in product innovation processes can be identified and what effects they have; 3) analysing whether an improvement in learning behaviour results in an increased improvement performance in product innovation processes.

In this section a brief summary of results and recommendations from Gieskes (2001) is provided. In Chapter 4, these results will be related to the research questions of the present thesis.

1) Effects of levers on learning behaviours. Through statistical analysis of the CIMA database, two main groups of levers that show effects on behaviours were found:

- *Punctuated levers*, which effectively stimulate learning behaviours in product innovation, especially during their initial implementation and set-up. These were found to be: L2 (process definition), L3 (organisation integration mechanisms), L6 (performance measurement), and L7 (design tools and methods). They have been assessed as having a *moderate impact* on learning behaviours.
- *Continuous levers*, which provide teams and individuals with knowledge, stability, freedom and the slack necessary for learning. These were found to be: L4 (human resources management policies), and L5 (project planning and control). They have been assessed as having a *high impact* on learning behaviours.

Two other levers were recommended for further analysis: L8 (computer based technologies), and L1 (product family strategy). This was because respondents had difficulties in distinguishing L8 (which will be addressed in the present thesis) from design tools and methods (L7). Moreover, ICT tools (L8) were associated with operational processes and not with learning processes. Therefore, it has been difficult to assess how they foster learning behaviours. Nevertheless, and also in Gieskes' thesis, it has been indicated how these tools can enable new ways of working (mobile and dispersed) (Zack, 1999b; Sanchez, 1996).

Concerning product family strategy (L1), decisions made about product variety, product structure and architecture, have not been shown to have a direct impact on the learning process. Nevertheless, the existence of formalised goals has been seen as extremely relevant to drive and stimulate learning. Therefore, the lever has been rephrased in terms of "strategy policymaking".

Moreover, it was pointed out that the levers in the CIMA model account for the 46% of the change in learning behaviour, which leaves 54% unaccounted for. New levers have been suggested for explaining the remainder of the change:

- Slack for learning (L9): this is seen as both the availability of resources and the psychological space for individuals to engage in different activities than the operational ones. Slack is not a sufficient condition for learning, but it is necessary.
- Individual learning style (L10): according to theory (Kolb, 1976), individuals have different learning styles and a relationship can be seen with innovation roles in the organisation (Boer and During, 2001).
- Management involvement (L11): culture and commitment have been suggested as prerequisites for effective learning. At the same time, their lack is a very strong barrier.

One very important result concerning the levers is that they are not independent instruments, in the sense that stimulating learning behaviour through one particular lever can result in changes in the application of others. The analysis of configurations of levers was a recommended task for further research.

2) Barriers hindering learning behaviours. A number of the barriers that were identified in practice relate to preconditions for learning. Examples are commitment, motivation for learning, slack, communication, and information loops. From the CIMA database, a lack of resources has been indicated as the most frequent barrier, although its absence is not a sufficient condition to enhance learning. Next, culture was mentioned as very frequent barrier, and related to a lack of commitment at managerial and operational levels. Similarly, a lack of communication is a very strong barrier for learning as it hinders the diffusion of goals from management, and horizontal knowledge transfers and sharing. An important observation is that they cannot be considered as the inverse of levers, as the mere implementation of levers is insufficient to overcome barriers. According to Gieskes (2001), in order to investigate these barriers, and especially their relationship with learning behaviours and levers, a methodology based on intervention has to be designed and implemented.

3) Association between behaviours and knowledge sub processes Knowledge subprocesses, as represented in literature (Huber, 1991), are described as Acquisition, Transfer and Sharing, Storage and Retrieval knowledge. Gieskes (2001) assumes that:

- Acquisition of knowledge can be improved by addressing learning behaviours related to developing knowledge (B2), experimenting with new solutions (B3), abstracting and generalising knowledge (B6) and assimilating knowledge from external sources (B8).

- Transfer and Sharing of knowledge can be improved by addressing learning behaviours related to integrating (B4) and transferring knowledge (B5), within and between phases of a project.
- Storage of knowledge can be improved by addressing learning behaviours related to integrating knowledge within projects (B4), abstracting and generalising knowledge (B6), embedding knowledge in vehicles (B7), and assimilating knowledge from external sources (B8)
- Retrieval of knowledge can be improved by addressing learning behaviours related to embedding knowledge into vehicles (B7).

In literature, metrics to assess how learning (modelled in terms of learning behaviours-Huber, 1991) takes place are not presented. The relationship between behaviours and subprocesses of learning provides the opportunity to measure this, through the assessment of frequency of learning behaviours[11].

Gieskes' refined model, derived from the answers to the three research questions is shown in figure 3.6 and is a relevant input for this thesis.

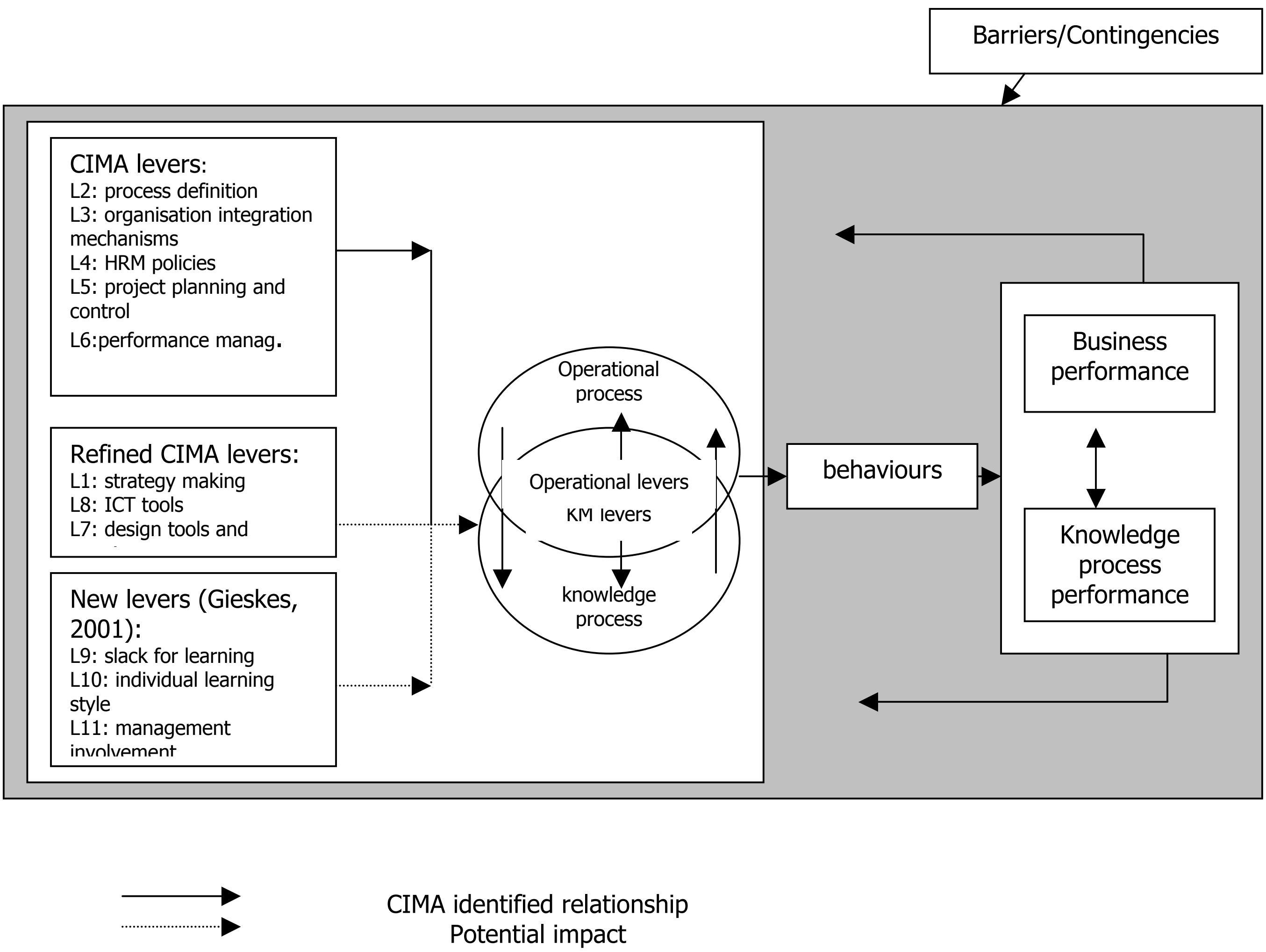


Figure 3.6: The refined CIMA model (Gieskes, 2001, p.171)

[11] Diffusion, as seen in the CIMA project, will not be considered in the present thesis; in Gieskes (2001) it is discussed how frequency and diffusion are not statistically independent.

3.5 SUMMARY AND CONCLUSIONS

In this chapter it has been explained how preliminary research work in the CIMA project contributes to this thesis, which can be summarised as follows:

- *The reference framework*: providing an overview on a preliminary set of variables, and the relationships among them, concerning learning in product innovation processes. This was a result of preliminary theory on organisational learning and innovation, and of the explorative research based on in-depth case studies. The model has been further used in the CIMA project to collect data on learning in product innovation.
- *The design of the research methodology*. In the CIMA research, both in-depth case studies and preliminary action research have been carried out. The investigation protocol and questionnaire developed in the explorative part of the research, and the experience in managing action research projects, has been extremely important to design the methodology for the present research. This experience has been useful both for in-depth cases and for action research in establishing the really relevant questions, to make the language in questions really clear and to choose usable scales to measure the variables. Specifically for action research projects, this experience helped in designing useful feedback schemes for managers so as to develop actions the company can take as a result of the mapping/feedback exercise, and further to improve the ability of the researcher to interpret company decision-making processes.
- *Definition of relevant levers in terms of measured effects on learning behaviours*. Only some of the levers indicated in the CIMA project (Boer et al. 2002) stimulate learning behaviours, others have been refined, and new ones introduced. In particular ICT appears to be effective, but it might well be that renaming it, or investigating it in more detail, in new research will show a higher impact than that detected by Gieskes (2001).
- *The existence of barriers hindering learning behaviours*. A number of barriers relate to preconditions for learning. Examples are managerial commitment, motivation for learning, slack, communication and information loops. Such barriers are not the inverse of levers, as the implementation of levers is not sufficient to overcome them.
- *Frequency of learning behaviours to measure effectiveness of levers on knowledge processes*. The relationship between behaviours and knowledge subprocesses has been assumed. With this assumption, it is possible to operationalise the effectiveness of levers on knowledge processes in terms of frequency of learning behaviours: in reality it measures to what extent people involved in knowledge processes are engaged in acquisition, transfer and sharing, storage and retrieval of knowledge.

Using this as a starting point, this thesis focuses on:

- *Innovative environments*. Previous research was concentrated on product innovation processes, this research moves on to innovative environments, including other typologies of projects (i.e. professional project of consultancy companies-Chapter 5).

- *Knowledge processes*. The objects of the thesis will be knowledge processes and knowledge management processes. Therefore, some definitions and specifications of the topic need to be provided, starting from the theoretical background.
- T*he overall configuration of levers to foster knowledge processes*, with specific reference to ICT tools within the configuration.
- *Some contingent variables*. Deriving from the CIMA project, research has been carried out in terms of analysing behaviours and levers in specific contingent situations (Chapman et al. 2001). In this thesis a limited set of contingent variables will be considered in order to analyse their impact on the configuration of levers adopted.

CHAPTER FOUR:
THE RESEARCH DESIGN

4.1 INTRODUCTION

The main goal of this chapter is to describe the overall research design, starting from the main research questions and then highlighting the main research design choices. Issues that will be dealt in this chapter are:

- The overall design of the research, its structure and phases.
- The main research questions of each phase, and their relationships.
- The main research propositions.
- The research investigation methodologies adopted.
- The analysis of the combination of conceptual and empirical levels of analysis, explaining the different research design choices.

Section 4.2 describes the principal phases of the research work, while Section 4.3, starting from results and propositions from theory and from previous research (summarised in Chapters 2 and 3), discusses which are the issues that require further investigation, setting the stage for new research questions. Sections 4.4, 4.5 and 4.6 present the main line of reasoning: each of them describing one research question, the propositions at each stage of the research, and the expected results. Finally Section 4.7 describes the overall investigation methodology adopted, outlining the reasons for specific choices.

4.2 THE OVERALL STRUCTURE OF THE RESEARCH WORK

This PhD thesis is aimed at answering three research questions:

RQ 1: What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge intensive, innovative environments, and which performances are related to them?

RQ2: Is a particular KM configuration aligned with a specific innovation strategy?

RQ3: How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?

In order to address these research questions, the research has been organised in different phases as depicted in figure 4.1.

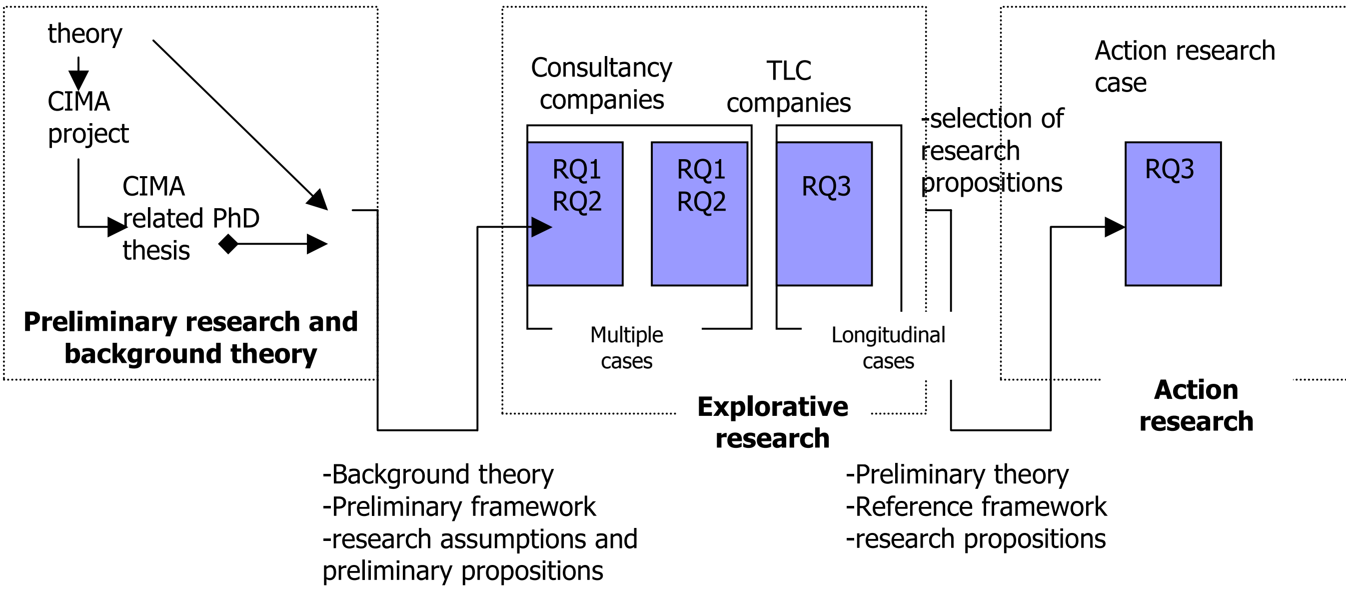


Figure 4.1: The phases of the overall research

There are three phases in the research:

1) *Preliminary research and background theory:* this phase of the research has been described in Chapter 2 and 3 of this thesis, and is summarised in terms of results in Section 4.2. The major contributions of this phase refer to background theory concerning organisational learning and knowledge management, which have been used to an extent in the CIMA project and in CIMA-related research work (Gieskes, 2001), and are to an extent original to the present work. These research results provide material to develop a background theory, a preliminary framework, and preliminary propositions that will be addressed in the explorative research.
2) *Explorative research:* a mainly empirical phase of this research work that addresses RQ1, RQ2 and, to an extent, RQ3. In more detail, in order to answer RQ1, firstly an exploration of knowledge management configurations in a specific research setting (successful consultancy companies) has been carried out, exploiting the experience of companies operating in this industry in managing and formalising knowledge processes. Then, the validity of results in two other professional knowledge intensive contexts (telecommunication companies) has been assessed. Turning to RQ2, first of all the association between successful KM configurations and innovation strategies has been analysed. Following this, in order to detect the alignment, cases with poor performances, where there were missing associations, have been analysed in order to investigate whether the missed association can be considered the cause of the poor results. In considering RQ3, the time dimension has been added to the research: companies where changes in the knowledge management configuration occurred (in particular due to implementation of new ICT functionalities), have been investigated and analysed.

   In order to perform the above research activities (which will be explained in greater depth later in this chapter), two phases of explorative research have been carried out. Firstly, stage 1, which mainly addressed RQ1 and RQ2 in the consultancy industry setting. The "multiple explorative case studies" methodology was applied using eight cases. The second stage, focusing on the two telecommunication (TLC) companies, has two important characteristics: first of all the companies operate in a different industry from consultancy, allowing a check on the validity of propositions derived for consultancy companies being applicable to other highly professional knowledge-intensive environments (RQ1). Secondly, they were investigated using a "longitudinal case study" methodology. Results from an investigation into one moment in time, ignoring the time dimension, can be used as static cases. In one stage of the investigation[12], the knowledge management configuration was related to poor performances: analysing if the missing association between innovation strategies and knowledge management configuration could be considered to be the cause of poor results, thus allowing one to check the alignment (RQ2). Then, by considering the analysis of changes in the configuration, and their relationship with performances over time, one can begin to answer RQ3.

3) *Action research* aimed at refining a selection of research propositions. In particular, the propositions related to the specific empirical setting of the companies involved in the action research were addressed. The main goals of this part of the research were to refine the propositions about the links between configurational change and performances in the specific context, and to investigate barriers to change and to effectiveness of change on performances.

From this overall architecture of the research work, and the aims expressed in the research questions, it is evident that there is an ongoing combination of the conceptual and empirical levels of the investigation as depicted in figure 4.2.

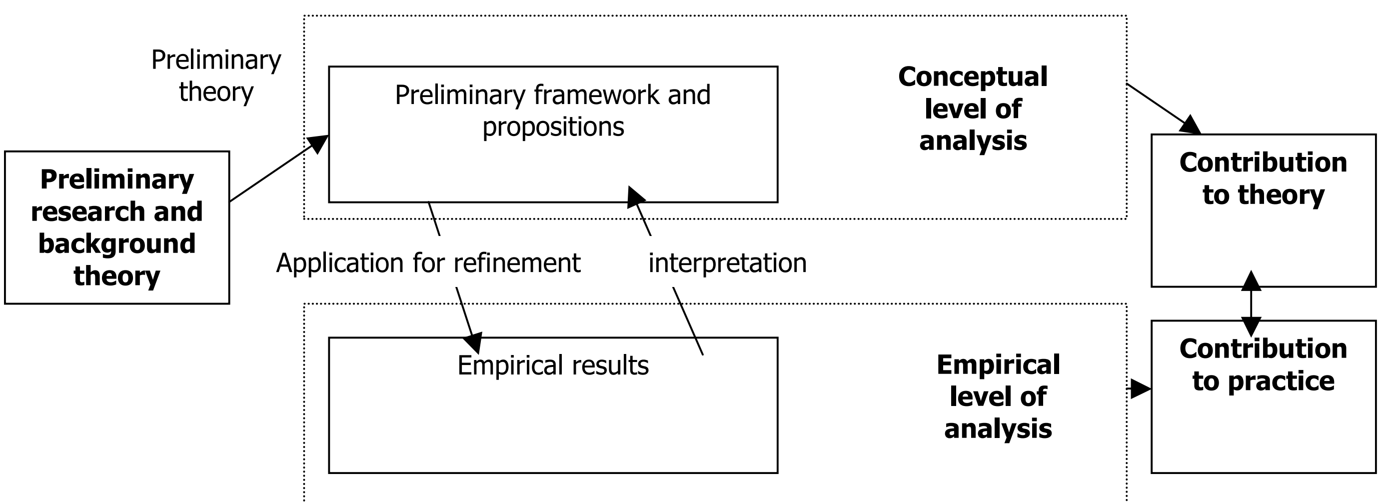


Figure 4.2: The conceptual and empirical levels of the research

12 Although the investigation of these cases is longitudinal, the check of the alignment is assessed in a static mode: the configuration, the innovation strategies and the performances are measured in one stage. The dimension of time is introduced only to address RQ3.

From the preliminary research and background, a preliminary framework based on preliminary theory is derived. Such a framework is essentially at a conceptual level albeit based on empirical evidence explained through theory. Two main processes will be designed and carried out in the present thesis.

1) *From conceptual to empirical level*: applying the framework in order to refine the research propositions. From this process it is possible to operationalise the framework, although the results will remain related to a specific research setting and cannot be generalised. So, at the beginning of the study it is necessary to explicate the characteristics of the research setting in order to understand the boundaries of the applicability of the results.
2) The *interpretation*: involves the explanation of the empirical results through theory. Through this process it is possible to refine the propositions and the framework before the next phase of the research. Naturally, interpretation has to take into account the extent of generalisability of the empirical results, which strongly depends on the investigation methodology adopted (in particular with regard to the external validity, Yin, 1994).

Results from the two processes provide contributions to theory and managerial practice.

In the following sections, the processes of interpretation and application in each phase of the research are described.

4.3 THE CONTRIBUTION OF THEORY AND PREVIOUS RESEARCH

This section shows the contributions of background theory (Chapter 2) and previous research related to CIMA project (Chapter 3) in terms of results and open issues underpinning the research questions of this thesis and the preliminary propositions. Several streams of literature (organisational learning, innovation management, strategic management, knowledge management, and ICT management) contribute to the topic of this research, while at the same time being extremely broad. Reviewing and focusing the analysis of literature on the research interest at hand[13], several issues emerged as relevant inputs to this thesis and provided the background to develop new research questions. The inputs of the earlier research can be summarised as follows:

- A multidimensional definition of knowledge, highlighting its peculiarities and challenges to be managed within the organisation: knowledge is commonly distinguished from data and information, it is based on human belief, it is a purposeful set of information, it is dynamically accumulated over time, it circulates at organisational level, it can be shared in tacit or explicit forms, it is created at the boundaries of the old through an incremental process.
- A definition of knowledge management: it is the process of designing, implementing, maintaining and improving a system of organisational mechanisms, information and communication technologies, and management systems (the levers) through which an organisation fosters and focuses individuals' and groups' behaviours in terms of assimilation and generation, transfer and sharing, capitalisation and reuse of knowledge, in tacit and explicit form, that is useful to the organisation. This definition relies on several issues coming from theory:

[13] The research interest of the thesis is "how knowledge processes can be supported in innovative and knowledge intensive environments".

- A framework of the knowledge process based on its phases: acquisition, capitalisation and reuse, transfer and sharing of knowledge. Each phase is characterised by participation of actors who can be internal or external to the organisation.
- The classification of types of knowledge. Particularly relevant for this thesis are classifications according to the level of explicitness of knowledge (epistemological dimension), the knowledge object (in terms of know what, know how and know why, addressed in Chapter 2 as classification according to the cause-effect relationship), and the level of abstraction and generalisation (knowledge can be contingent and generalised) (classification according to the level of specificity).
- A categorisation of the levers of learning in terms of ICT, management systems and organisational mechanisms has been carried out, considering how, according to theory, each of them stimulate knowledge processes, especially considering the target users they address (intra, group and inter clusters).
- Knowledge management directly influences human behaviour, and through this company performance.
- The identification of critical issues that enhance knowledge processes in innovative contexts: abstraction and generalisation, double loop learning, experimentation, and unlearning.

For what concerns previous research, the main contribution is a refined model for learning in product innovation in terms of:

- The identification of all the possible levers (under different headings) for fostering knowledge processes. The levers have been systematised and their effectiveness in knowledge processes has been assessed. In particular, a more detailed analysis of the role of ICT has been recommended.
- The identification of learning behaviours of people operating in knowledge processes. The frequency of such behaviours represents to what extent they are involved in the knowledge processes.
- An operationalisation of learning performances in terms of improvement performances, people performances, and business performances. Literature identifies how knowledge management affects the results of business processes, in the sense that knowledge available can facilitate operational activities (Davenport et al., 1998; Zack, 1999a; Bierly and Chakrabarti, 1996). Despite this, there was a lack of an operationalisation of performances of knowledge management. One difficulty is that business performances can be considered as only an indirect measure of knowledge management effectiveness (Szulanski, 1995).
- A list of contingent variables, which influence knowledge processes.
- The concept of barriers to learning, which are not the inverse of levers.

Despite these contributions, a number of issues remain unexplored which can be addressed through new research questions.

- First of all, the need for a *"system approach" to knowledge management* in terms of relevant variables enabling knowledge processes. Preliminary theory has mostly focused the attention on one class of variables at a time, without developing an approach that considers all the variables together. Considering the "system approach" implies investigating the relationships among the classes of levers, and their joint global effect on knowledge processes. In particular, literature (Meso and Smith, 2000) specifically addressed ICT from the technical point of view when discussing which solutions can improve the management of knowledge. Thus, the challenge for this thesis is twofold: on a more general level, by focusing attention on the "overall system of levers", characterise knowledge management and its effects on knowledge processes. At a more specific level, assess the role of ICT in enabling knowledge processes, with particular attention to its impact on choices concerning the other levers and their effects on performances.

- The topic of *functionalities* and *forms* of levers is related to the previous issue. The functionality of an enabler can be considered as the purpose for which it is designed (Stein and Zwass, 1995). In order to realise a functionality, several "forms" or solutions can be shaped for each lever (Mintzberg, 1985). It is important to point out that most of the theory and preliminary research concerned the study of levers in terms of solutions (Walsh and Ungson, 1991; Quinn et al. 1996a; Davenport et al, 1998). On the other hand, by addressing functionalities, one can analyse knowledge management at a more general level, taking into account that different forms can realise the same functionality.
- The role of *contingent variables*. The effectiveness of levers on behaviours can also depend on the contingent situation of each company (Chapman et al., 2001). In previous research, a set of contingencies was developed, but the effects on the overall learning process, and on the levers to implement it, have not been analysed.
- The *relationship between the knowledge process and the operational process*. In case studies during the CIMA project it emerged that levers implemented to support operational processes can potentially also stimulate knowledge process. Nevertheless, Gieskes (2001 pp.168) found that "…*an effective configuration of levers for managing the innovation process may be different from an effective configuration of levers for stimulating the learning process…*" so that the two levels of analysis are separated. Further, analysis should be developed in order to investigate the levers in operational and business processes.
- The *relationship among variables*. Most of the previous research has been dedicated to the identification of relevant variables in the CIMA model. So far, results can only provide a few insights into the relationships among them. An analysis of configurational change can help in investigating such relationships, determining which effects on the overall set of levers are due to a change in the functionality of one of them.
- The levels of *evolution of knowledge management.* Companies involved in the previous research show different "maturity" levels in the evolution of their learning processes, and in the way knowledge management practices support them. Some companies are aware of the importance of knowledge processes and deliberately implement levers to support them. Others are not so mature. A deeper analysis of the evolution of a knowledge management system, and its effects on knowledge processes and on its performances, is an issue that should be pursued.

Some of the issues remaining open from the theory and preliminary research have been used to establish the research questions for this thesis. In the following sections, a detailed description of the research questions, and of the research steps and methodologies designed to answer them, is provided.

4.4 THE IDENTIFICATION OF KNOWLEDGE MANAGEMENT CONFIGURATIONS (RQ1)

The first research question is phrased as follows:

RQ 1: What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge intensive, innovative environments, and which performances are related to them?

In particular, answering this first question requires answering the following subquestions:

RQ1.1. Which are the *functionalities of levers* fostering knowledge processes?

RQ1.2. Which *KM configurations* (in terms of ICT, organisation and management tools) are successful in terms of performances of the knowledge process?

RQ1.3. What are the effects of each *KM configuration of levers on performance?*

RQ1.4. Which *types of managed knowledge* characterise each configuration*?*

RQ1.5. Are the configurations of levers adopted in consultancy companies also valid in other knowledge-intensive industries?

The steps followed to answer these research questions, are outlined in figure 4.3. In the grey boxes the empirical phases are highlighted, while phases outside are conceptual ones.

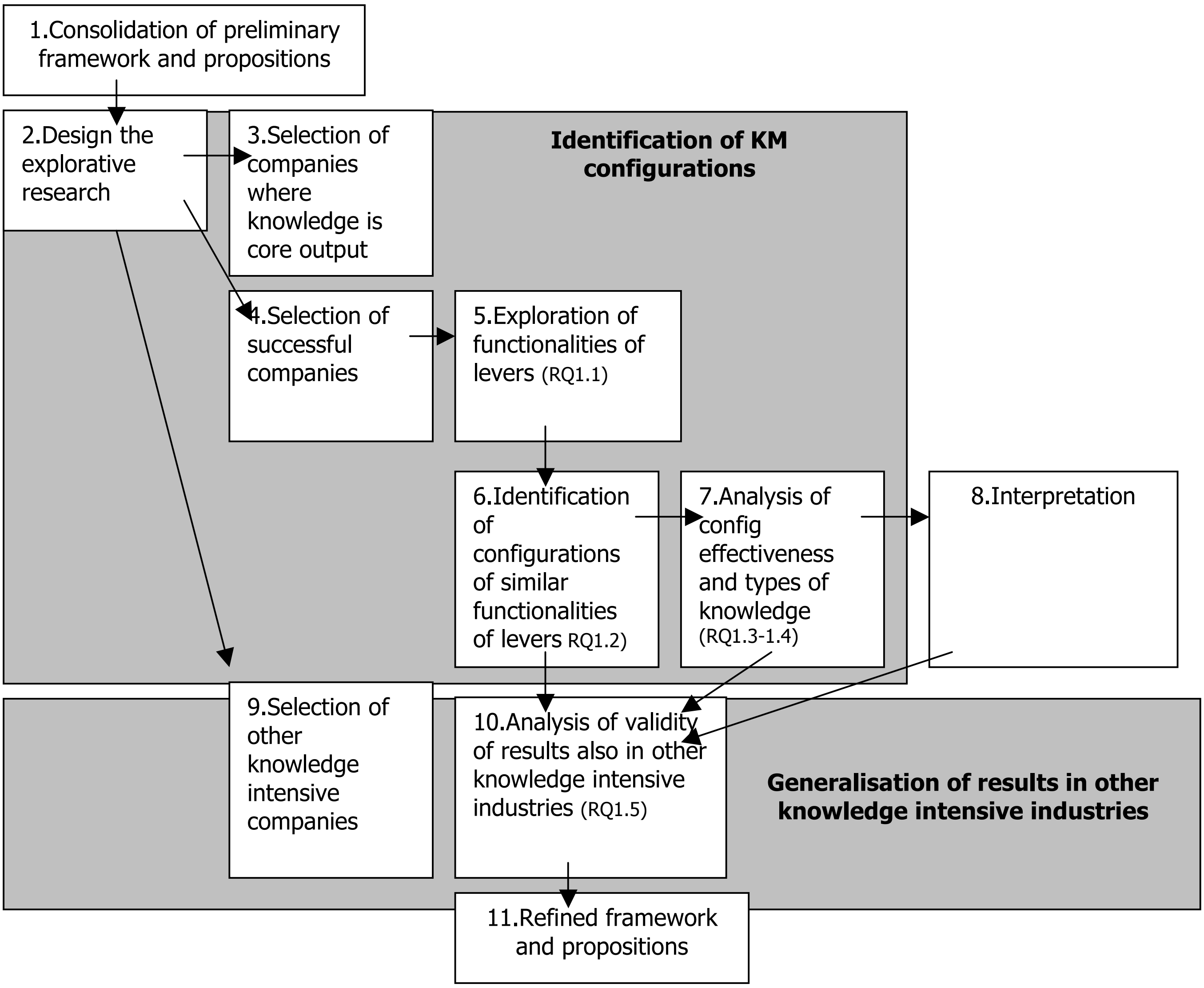


Figure 4.3: The steps of the research concerning RQ1

As represented in figure 4.3, the main activities required in order to answer RQ1 can be described as follows:

Consolidation of the framework

1) *Consolidation of the framework and definition of preliminary propositions*. The preliminary propositions for this research are based on background theory and CIMA-related research results. However, due to the explorative nature of the research, these preliminary propositions (P.P) are rather open since they have to be refined later. In more detail, the propositions are:

P.P 1 Different configurations of levers (ICT, organisational mechanisms and managerial systems) lead to different performances

P.P 2 Different configurations of levers (ICT, organisational mechanisms and managerial systems) support the management of different types of knowledge

As noted, these propositions are very general and explorative, but they will be further detailed in Chapter 5, with specific attention to those levers implemented by successful companies.

Identification of the knowledge management configurations

2) *Research design*. This activity is related to defining the methodology to be used to address the research questions. It involves methodology, an investigation framework, and an investigation protocol. In order to address the research questions, and refine the preliminary propositions, some methodological requirements have to be outlined: a) the methodology should be *explorative* as it aims to provide an operationalisation of conceptual variables coming from theory, b) *the scope of the variables involved is wide* throughout the organisation so that different roles should be involved, and c) it should provide material for further *interpretation* of results. Due to these peculiarities of the research, multiple case studies have been identified as the appropriate methodology (Section 4.7) for this part of the research.
3) *Definition of the research setting*: a selection of companies where knowledge is the core output of the business process. As the main goal is to identify knowledge management configurations, the research is designed to involve companies where knowledge is extremely relevant to their business and where knowledge management practices are consolidated (i.e. the management consulting industry). In fact, as knowledge is the core output of such companies, they will have paid a great deal of attention to the design, implementation, maintenance and improvement of systems to facilitate management of knowledge processes.
4) *Selection of successful companies operating in the industry*. If knowledge is the main output of the considered companies, and they are successful in their business performance (i.e. margins, revenues), then it can be assumed that the implemented configurations are successful in this industry.
5) *Analysis of the functionalities of levers implemented in the companies*. Through the investigation framework developed, the functionalities of ICT, management systems and organisational mechanisms are explored in the companies.
6) *Identification of the configurations found in the empirical investigation*. Through the investigation of the functionalities of levers, and their similarities in different companies, configurations can be identified and described. Similarly, it will be possible to describe the configurations according to the forms and solutions that have been implemented by the companies in order to realise these functionalities. Moreover, each configuration can be described according to the type of knowledge it supports.
7) *Analysis of the configuration effectiveness*. Although all the companies are successful in terms of business performances, the effects of the configuration on the defined dimensions of performances (knowledge process performances, people performances and business performances) are investigated in more detail.

Interpretation

8) *Interpretation*. At this stage, the results are mainly empirical, based on the operationalisation and application of the preliminary conceptual framework. Outcomes are specific for the research setting

where the investigation was carried out. The interpretation of these results through theory is an important milestone in the thesis and it leads to two outcomes: firstly, it validates the conceptual framework and its operationalisation; secondly, it allows one to build new theory (for example on knowledge management configurations) based on the obtained results.

Generalisation of results in other knowledge intensive industries

9) *Selection of other knowledge-intensive companies*. The derived configurations concern a specific industry. Other knowledge-intensive industries are included in the analysis in order to see if the results are valid also in other research settings and whether there are peculiarities in this new setting. This issue concerns the generalisability of results.
10) *Analysis of validity of results* (in terms of configurations and performances) also in other knowledge-intensive industries. An analysis of the functionalities of the levers implemented, and of the configurations, has been carried out in the new research setting.

Summarising results concerning RQ1

11) *Refined framework and propositions*. From results obtained answering RQ1, a set of refined propositions is developed[14]. They can be categorised in:

Propositions concerning:

- *the functionalities of levers (referred to ICT, organisational mechanisms, management systems) implemented to stimulate knowledge processes*
- *the description of functionalities of levers in each configuration*
- *the links between configurations and performances*
- *the links between configurations and types of knowledge managed*
- *the theoretical interpretation of empirical findings*

4.5 THE ALIGNMENT OF KM CONFIGURATIONS WITH INNOVATION STRATEGIES (RQ2)

The second research question was formulated as follows:

RQ2: Is a particular KM configuration aligned with a specific innovation strategy?

In order to be able to check the alignment, it is important to characterise those innovation strategies that are associated to successful KM configurations To this end, RQ2 can be investigated using the following two subquestions:

RQ2.1 Is a KM configuration associated with a specific innovation strategy?

RQ2.2 Does an innovation strategy influence the success of a knowledge management configuration?

[14] It has to be remembered that the propositions will be primarily developed according to results coming from consultancy industry. Then their validity in other knowledge intensive industry will be checked.

Several activities have been carried out in order to provide answers to these questions, as represented in figure 4.4.

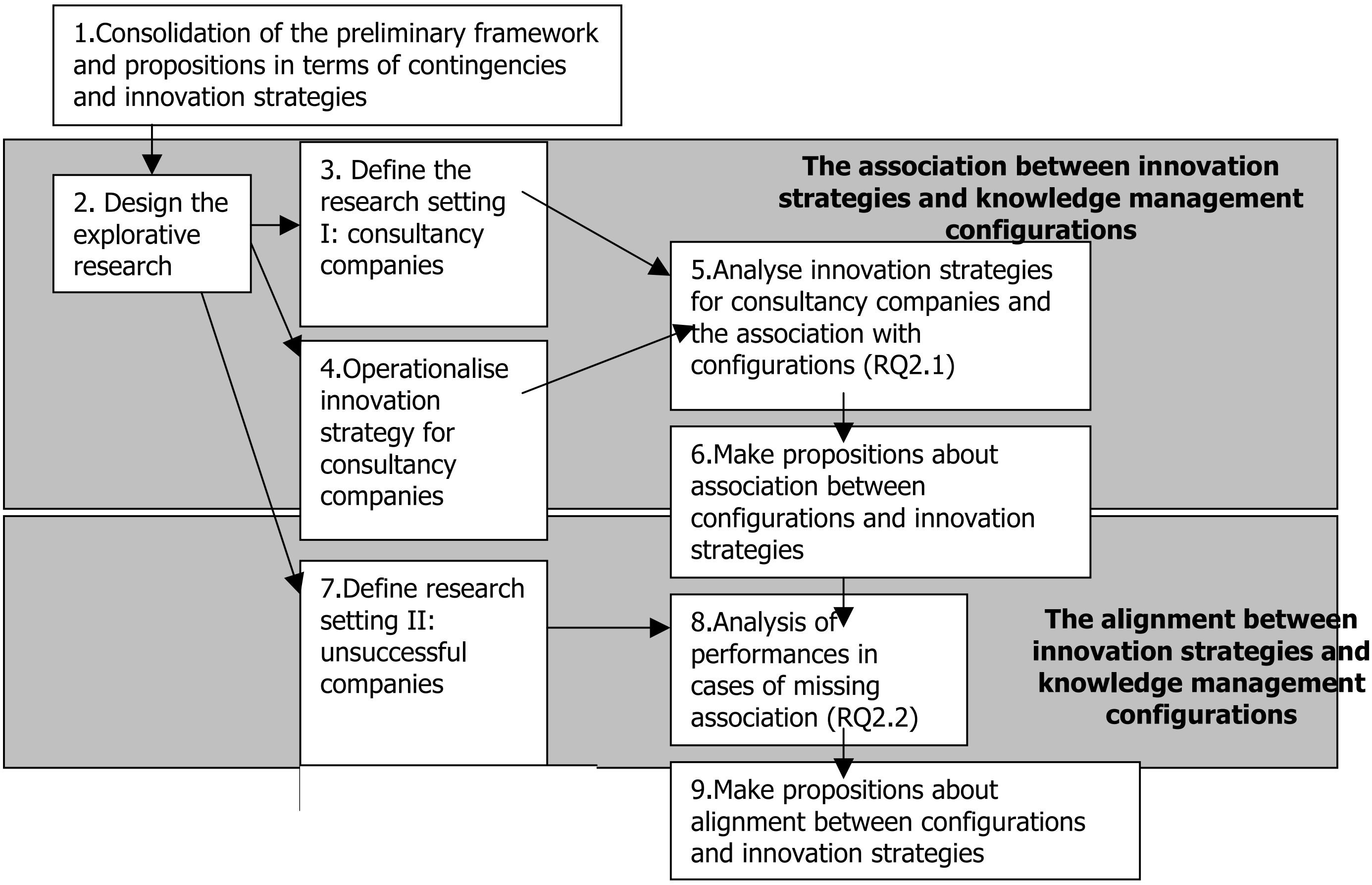


Figure 4.4: The steps of the research concerning RQ2

Various activities are carried out to answer to RQ2, which can be considered as explorative:

Consolidation of the framework

1) *Consolidation of the preliminary framework and propositions in terms of contingencies and innovation strategies*. In the framework from the CIMA-related research, a preliminary list of contingencies was provided. In this thesis, only one variable will be investigated in detail: "innovation strategies". This has been identified as extremely relevant for knowledge processes, both in literature and previous research (Gieskes, 2001; Hansen et. al. 1999; Bartezzaghi et al., 1998) and from empirical results from the investigation of consultancy companies (Chapter 6).

P.P3 The innovation strategies adopted by companies influence the knowledge management configuration implemented and its effects on performances

The association between innovation strategies and knowledge management configurations

2) *Design of the explorative research*. This activity is related to that developed for RQ1. It relates to the development of methodology, an investigation framework and a protocol. One particular issue, which is very important at this stage, is the difference between "association" and "alignment". The first investigation is carried out using the same sample of successful consultancy companies as for

RQ1. This allows one to investigate which innovation strategies are *associated* with a successful KM configuration. The *alignment*, on the other hand, implies the analysis of performances: it is necessary, from the methodological point of view, to look for cases where the association is not verified and, at the same time, performances are poor. If the reasons for these poor performances can be referred to the missing association, then it is possible to assess the alignment between innovations strategies and configurations. As with RQ1, the methodology adopted is "case studies" involving both consultancy companies and the other professional knowledge-intensive companies.

3) *Define the research setting I*: *consultancy companies*. This activity involves defining the characteristics of the sample.
4) *Operationalise innovation strategy for consultancy companies*. As the industry is very specific, it is necessary to clarify the context of the investigation, operationalising the innovation strategies for these companies through theory. In effect, a set of preliminary propositions can be derived, and this is discussed in Chapter 6.
5) *Analyse innovation strategies for consultancy companies and the association with configurations*. Using the propositions and the investigation framework, an empirical analysis of innovation strategies of consultancy companies has been carried out. Following this, the association of types of innovation with knowledge management configuration is detected and discussed.
6) *Make propositions about the association between configurations and innovation strategies*. Based on the results a number of propositions are derived. In particular:

Propositions concerning

- *associations between innovation strategies (with the focus on the degree of innovation) and KM configuration for successful companies*
- *associations between innovation strategies (with the focus on origin of innovation) and KM configuration for successful companies*

The alignment between innovation strategies and knowledge management configurations

7) *Define the research setting II*: this will involve unsuccessful companies which, at the same time, do not show an association between innovation strategy and knowledge management configuration. The setting is the same two companies where longitudinal case studies were carried out.
8) *Analysis of performances and configurations in event of missing association*. The two telecommunication companies will be investigated in order to see whether unsuccessful performances can be explained by the missed association between innovation strategies and KM configuration.
9) *Make propositions about alignment between configurations and innovation strategies*. This activity involves the refinement of previous propositions considering the effects of the association on performances.

Through answering RQ1 and RQ2, conclusions can be drawn. The explorative research has been designed to combine the conceptual and empirical levels of analysis. The preliminary framework and propositions (from theory) are operationalised in a specific research setting (consultancy companies) in terms of categorisation of enablers, contingencies performances and innovation strategies. At the empirical level, knowledge management configurations, and relative links with performances on knowledge processes and innovation strategies, are developed. Two challenges are pursued in this thesis. The first is *interpretation:* explaining results through theory allows the validation of the conceptual framework and its operationalisation. At the same time it is possible to generate new theory from these results. The second is *generalisation* of the framework and its operationalisation, which is achieved through the application of the framework in two other knowledge-intensive companies that are not operating in the consulting industry. In terms of this issue, it should be noted that other research works is on-going: applying the model through the same investigation methodology in other industries (engineering companies, manufacturing companies, SMEs…) (Corso et al. 2002).

4.6 THE ANALYSIS OF CONFIGURATIONAL CHANGE (RQ3)

The third research question was formulated as follows:

RQ3: How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?

Again, this research question can be answered through a set of subquestions:

RQ3.1: what changes to the overall knowledge management configuration are stimulated by the change of one of the levers (i.e ICT functionalities)?

RQ3.2 what are the effects of configurational change on performances?

RQ3.3 what barriers to change and its effectiveness emerge?

RQ3.4 does the configurational change influence the innovation strategies adopted by a company?

In order to answer the research question, the activities represented in figure 4.5 are carried out.

The activities to be carried out to address RQ3, are:

Consolidation of framework

1) *Consolidation of framework*. At this stage, as discussed in Sections 4.3 and 4.5, a set of propositions from explorative research will form the basis. These propositions describe the KM configuration, its effects on performances, and the alignment with innovation strategies. The focus of the third research question is, on the other hand, to investigate the configurational change. Due to the explorative aim of the research and the lack of preliminary investigations about configurational change (Chapter 2), the first stage of the dynamic research aims at developing propositions to be further refined in the action research stage.

Preliminary explorative research about configurational change

2) *Design the research I*: *definition of methodology*. This activity deals with the choice and design of the methodology to address RQ3. At this stage no insight has yet been developed concerning configurational change, and therefore the activity concerns the design of an explorative phase of the research in a dynamic setting. Results and propositions coming from this research will help in

focusing and managing the following action research phase. The methodology chosen is longitudinal case studies, aimed at exploring the effects of configurational change on knowledge processes and performances.

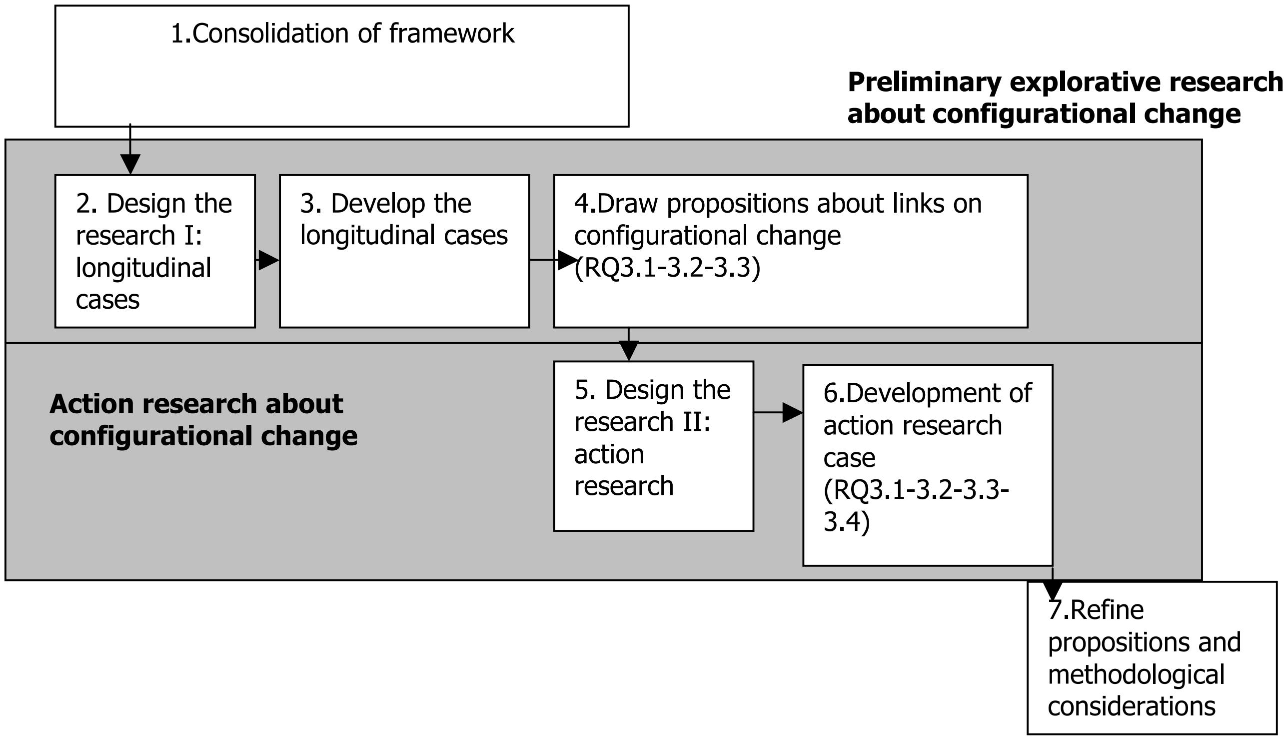


Figure 4.5: The steps of the research concerning RQ3

3) *Develop the longitudinal cases*. Two longitudinal cases (the two telecommunication companies) have been developed. The configurational change and the effects on performances have been investigated in the two companies (before and after the configurational change) where a change in ICT functionalities occurred.
4) *Draw propositions* about configurational change, in particular

Propositions concerning: ▪ *the change in the configuration due to changes in ICT functionalities* ▪ *the existence of barriers to change*

Action research about configurational change

5) *Design the research II: action research*. The second dynamic approach concerns the use of action research. At this stage, reasons for adoption of the participative approach are outlined (Section 4.7). The action research approach itself has to be formalised and consolidated in order to set and plan phases of intervention. The main goals of the action research are to 1) refine the propositions about

the links between configurational change and performance, in a specific research setting; 2) investigating barriers to change and to effectiveness of change on performances.

6) *Development of action research case*. As will be described in chapter 8, the selected case concerns the implementation of a new knowledge management system in a highly professional knowledge intensive company. The implementation is not the object of the research, but it is the empirical setting for investigating the process of change in the configuration. Therefore, the action research approach has to be focused on the refinement of research propositions that reflect the characteristics of the empirical setting.

Conclusions and results

7) *Refine propositions and methodological considerations*. It is important to specify and discuss the process followed in the action research approach since this influences the validity of the propositions drawn for two reasons: first of all to understand the role of the researcher in the action research project and, due to the relationship with the empirical setting, to understand the ability to interpret and generalise the results.

A synoptic table of the research structure and the line of reasoning is provided in figure 4.6. In this figure the three stages of the research, and their relationship with the research questions and methodology adopted, are represented:

- The RQ1 and RQ2 are addressed through multiple case studies. Nevertheless, as explained in Sections 4.3 and 4.4, two research settings have been investigated: 8 consultancy companies, and 2 companies operating in the telecommunication industry. These latter companies were also used in longitudinal case studies, but the time dimension is not relevant in considering RQ1 and RQ2. Therefore, single stages of analysis for these two companies will be analysed, without considering the time dimension.
- The RQ3 is addressed through a dynamic methodology: the longitudinal cases are developed in order to obtain a preliminary set of propositions which are then refined through action research approach will be carried out.

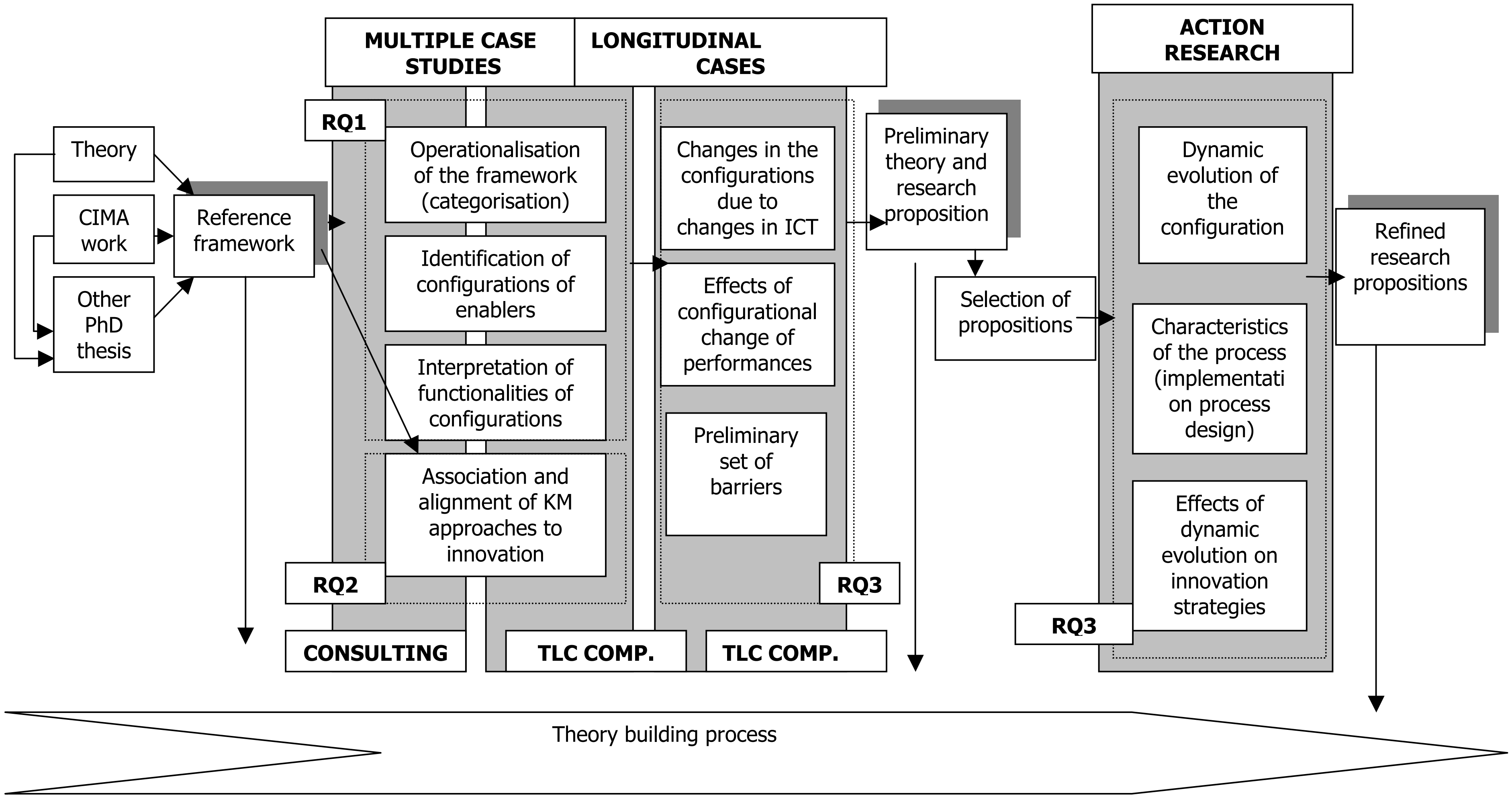


Figure 4.6: Overall line of reasoning and structure of the research

4.7 THE METHODOLOGY IN THE RESEARCH

This chapter justifies the methodological choices that have been made. It is important to underline that while in this chapter the main choices are explained, in each subsequent chapter the investigation methodology (in terms of investigation protocol, questionnaire, and research setting) is described in much more detail.

In order to introduce the different methodologies, a framework is derived starting from Yin (1994); case studies can be classified according to three dimensions as represented in figure 4.7:

- According to the *approach*: case studies can be explorative, descriptive or explanatory. Explorative cases are used to answer research questions that *investigating* which phenomena happen in specific situations, descriptive cases for *describing* such phenomena, explanatory cases in *arguing why* they happen.
- According to the *time*: they can be retrospective or longitudinal. Retrospective cases represent a picture of the company as the result of previous actions; a longitudinal case, on the other hand, refers to different pictures taken over time, in order to study the evolution of variables.

According to the *number*: single cases are usually explorative or descriptive, multiple case studies, on the other hand, support the process of explanation of some of the variables involved.

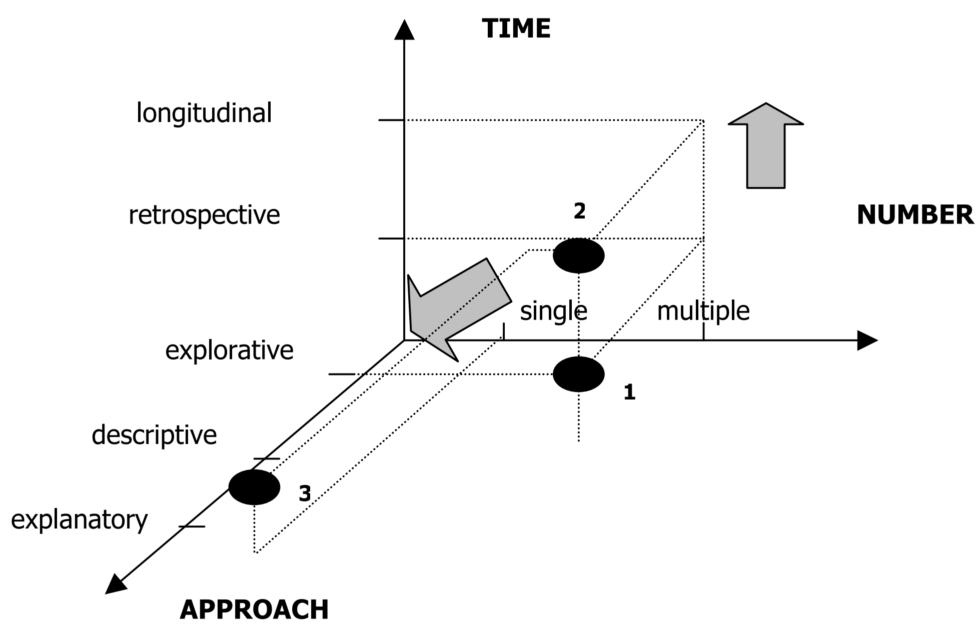


Figure 4.7: The typology of case studies

To address RQ1 and RQ2, the analysis is mainly explorative, based on multiple retrospective cases (see figure 4.7, point 1). The aim is to investigate the successful KM configurations. The outcomes from these cases are mainly descriptive and related to the context. Two issues are challenging at this stage of the research:

- The research setting: the research setting should be identified so as to allow the comparison with results from this first stage of explorative research.
- The methodology design should achieve the prerequisites for validity of case study research (Yin, 1994): construct validity, internal validity, external validity, and reliability.

Chapter 5 explains how the case study methodology has been designed in order to adequately deal with these issues.

In order to address RQ3, on the other hand, the time dimension is required. Therefore, the investigation, which is still explorative, moves on to multiple, explorative and longitudinal cases (figure 4.7, point 2).

Finally, the third stage of the research is mainly for "explaining" what happens within knowledge management configurations and in knowledge processes when one of the levers (i.e. ICT) changes. In this case, the methodology adopted concerns one case study, with explicative purposes, and longitudinal given that the time dimension is extremely relevant. Nevertheless, action research presents the peculiarity of "participation", which differentiates it from case studies, and requires further discussions (Chapter 8).

The explorative research has been first carried out through **multiple case studies**. Case study methodology has been selected to answer the RQ1 and RQ2 for several reasons:

- The *explorative peculiarity* of the research. The research is characterised by an explorative purpose in terms of which variables are relevant for managing knowledge processes, and what are the relationships between them. Relying on quantitative research would not realise the same results, as it would assume that an operationalisation of relevant variables already had been carried out.
- *Relationship with other steps of the research* and the methodological recommendations coming from them. In the CIMA-related research, a preliminary set of variables has been explored through in-depth case studies and then operationalised into methodology. Propositions underlying this preliminary framework and the included variables have already been investigated through a quantitative approach (Gieskes, 2001, pp.196-198).
- *The focus on many variables and difficulty in defining the independent variable.* As indicated by Gieskes (2001), many variables are involved in knowledge processes modelling, in terms of levers, barriers, performances and contingencies. Due to the high number of variables, it is not always possible to formulate propositions on the cause-effect relationships especially because the independent variable is not always clear in advance. The use of case studies allows all these variables to be investigated
- *The difficulty in measuring intangible variables* (De Maio et al. 1994). Some of the variables investigated can be easily assessed as they are related to organisational design or technological choices (i.e. use ICT tools, definition of roles, adoption of performance measurement systems…). Others are more difficult to operationalise and measure as they are largely intangible (i.e. learning behaviours). Therefore, their operationalisation is best addressed through the cases studies.

The reasons for adopting **longitudinal case studies** are twofold:

- *The relevance of "time dimension"*. Outcomes concerning RQ1 and RQ2 will be obtained from the multiple case studies. These results concern the characteristics of the configuration, and its links with performance and innovation strategies. However no outcome is available about configurational change. Analysis over time requires moving from static to longitudinal cases, analysing what happens at each step of the investigation and the drivers and characteristics of change over time.
- *The explorative characteristics and relationship with action research approach*. The goals of the action research approach are to refine propositions coming from explorative analysis and to investigate barriers to change, through explaining how changes take place. Further, the existence of a preliminary set of propositions, coming from the static and longitudinal case studies, improves the reliability of the action research case study.

As widely described in literature, the **action research approach** requires much more description, (Coughlan and Coghlan, 2002; Gummesson, 2000; Reason, 1998) but there are various approaches. A detailed description of the action research approach adopted in this research work, and how it is related with the approaches found in literature, is provided in Chapter 8. It is important to highlight some peculiarities of the action research methodology and justify the reasons for its adoption. According to Coughlan and Coghlan (2002), action research is "research in action" and not "research on action" and, as such, the key characteristics of this research approach are (Coughlan and Coghlan, 2002; Gummesson, 2000):

- *Participative and interactive*: members of the system actively participate in the plan-do-check-act loop;
- *Concurrent with action*: the research activities are performed together with the action;
- An approach to *problem solving;*
- It always involves two goals: solve a problem for the client and contributing to science. From the practical point of view, research and action are concurrent, and so it is a challenge of the research to make things happen and have time to reflect, abstract and lean;
- It aims at developing holistic understanding since researchers have to recognise and deal with complexity. Many variables are changing at the same time, some of them are formal, technical and structured, some informal;
- It requires an *understanding of the ethical framework* since the researcher has to understand values and norms in the particular context;
- It includes *all types of data gathering methods*: action research can use on both qualitative and quantitative methods for gathering data. This implies that these methods are shared with people within the company and thus are perfectly integrated in the research process.;
- It is *fundamentally about change*: action research is applicable to the understanding, planning and implementation of change;
- Action research requires a *breadth of pre-understanding of the corporate environment and the condition of business*. This understanding does not only concern the specific topic the researcher is analysing (i.e. product development), but also organisational systems and the dynamics of the organisation in its contemporary business environment;

- The action research paradigm *requires its own quality criteria*. Action research cannot be evaluated according to traditional research parameters.

In figure 4.8, the main differences between action research and traditional research are highlighted.

In this thesis, several characteristics of the research have led to the adoption of a participative approach:

- The overall research *objective*. The thesis aims at developing *actionable*, thus rich, knowledge about the knowledge processes and knowledge management systems.
- The third *research question*, which is fundamentally about change and its effects on performances and knowledge processes.
- The *complexity* of the topic. The number of variables (implicit or already explicit at the beginning) and their changes over time require a strong involvement of the researcher in order for these variables and changes to be understood and explained.

	Traditional research	**Action research**
Aim of the research	Universal knowledge Theory building and testing	Knowledge in action Theory building and testing in action
Type of knowledge acquired	Universal Covering law	Related to the particular Situation
Nature of data	Context free or Contingency related	Contextually embedded
Validation	Logic, measurement Consistency of prediction and control	Experiential
Researcher's role	Observer	Actor Agent of change
Researcher's relationship to setting	Detached Neutral	Immersed

Figure 4.8: The main differences between action research and traditional research methodologies (from Coughlan and Coghlan, 2002, p.224)

- The overall *structure* of the research. The action research case is not an isolated experience. It is part of the overall research work involving explorative case studies to develop the first interpretative model and preliminary research propositions. The participative (or co-operative) inquiry approaches discussed in literature (Torbert, 1990; Reason, 1998; Cooperrider, 1996; Argyris, 1997) design the research process through the cycling of several stages: *propositional knowing* where the people involved (researchers and subjects) define the questions to explore, and the methodology; *practical knowing* where they apply the methodology (together or separately) in their practice; *experiential knowing* where they arrive at new forms of encounter with their world, and *presentational knowing* when they find ways to represent this experience in significant patterns which lead to new propositions. The main issue concerning this process is that propositions are mainly related to the empirical setting and come from the field, derived from the interaction between researchers and people operating in the company. Starting from these considerations, the possibility of relating more traditional research (as explorative research) to an action research process can be seen as a great opportunity: propositions do not come directly from the participative inquiry, but they are derived from an explorative analysis whose results have been explained through theory. Establishing new propositions at the beginning of the action research stage, enables the researcher, acting together with people in the company, to further refine the propositions by adding new variables that were not considered in advance, to reconsider the operationalisation of variables for the company involved, and to remove apparently irrelevant variables. In other words, starting with preliminary propositions makes the proposition-setting phase in the action research process an opportunity for new refinements.

4.8 SUMMARY AND CONCLUSIONS

In Chapter 4, the overall research design has been outlined in order to first of all explain the choices made in the different stages of the thesis, and then to make explicit the line of reasoning. Several elements have emerged in the chapter:

- The importance of background theory and the relationship with preliminary research works.
- The research questions addressed in the research and their different perspective: RQ1 and RQ2 are mainly explorative, while RQ3 is explanatory. Moreover, the first two need a static analysis, while the latter is set in a dynamic research setting.
- The adoption of several research methodologies: the use of multiple case studies to answer RQ1 and RQ2, while longitudinal cases and action research to answer RQ3.
- The different research settings, which will be in more detail described in the specific chapters. The focus is always on knowledge-intensive professional companies managing innovative projects. Nevertheless, other contingent factors (industry, size, culture), influence knowledge processes. Although this thesis is focused on investigation of one specific contingent variable, the influence of the others should not be overlooked.

In particular, in order to make the research process more comprehensive, an overall framework, based on the description provided in this process is shown in figure 4.9. In the figure, the process followed to answer different research questions is highlighted:

- In order to answer RQ1 and RQ2, a set of preliminary propositions based on theory and previous research is set. A first research process (multiple case studies), and the results deriving from it, allow the researcher to develop a set of propositions (which will be specifically referred to each research question). Those propositions will be the input for a second research process (longitudinal case studies) that is aimed to revise (in terms of generalisation or refinement) some of them and generate new ones. Basing on those propositions new research questions and research processes can be designed (Chapter 9).
- In order to answer RQ3, a set of preliminary propositions is not available; therefore a first research process (longitudinal case studies) will be carried out in order to develop propositions to be further refined using the second research process (action research). From results coming from it, a set of

refined and new propositions will derive. They will be the basis to design new research questions and processes (Chapter 9).

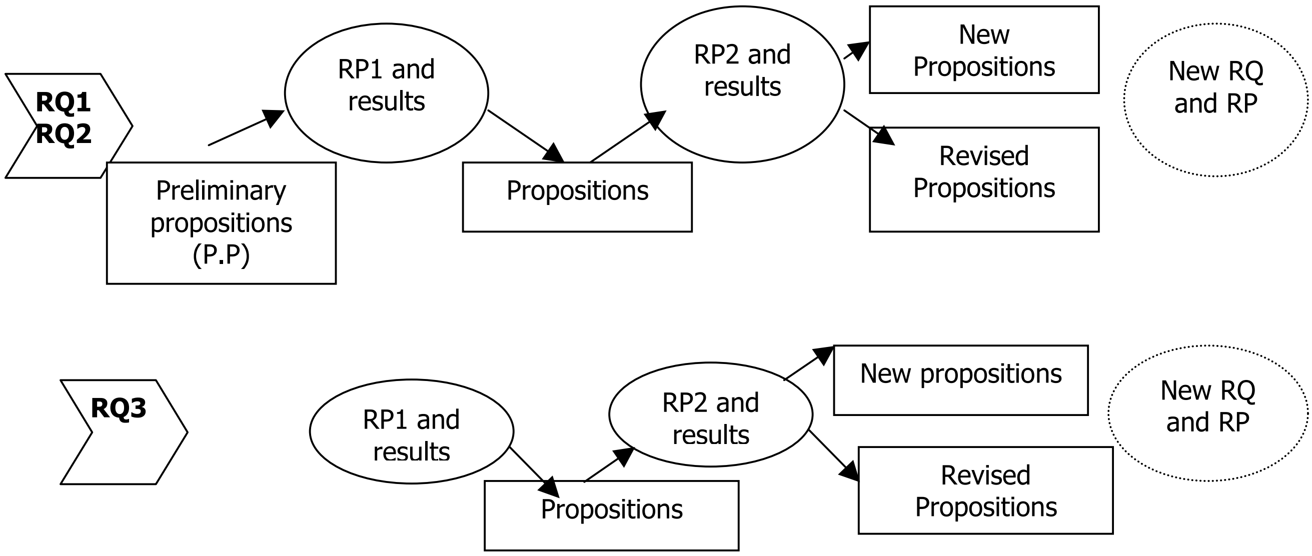


Figure 4.9: The research process and outputs

Starting from these considerations, in order to make the thesis more readable, and hopefully comprehensive, it is organised along the lines of the empirical setting investigated (consultancy companies, telecommunication companies, action research case) and the types of investigations carried out: with the results concerning each research questions described as they are established. In more detail:

- Chapter 5 concentrates on the first stage of the explorative research, addressing RQ1. In particular, the chapter provides results that answers RQ1 for the management consulting industry.
- Chapter 6 also focuses on the first stage of explorative research, addressing RQ2. It provides results from the investigation into innovation strategies in the management consulting industry.
- Chapter 7 reports on the investigation of the two TLC companies. Results concerning RQ1, RQ2 and RQ3 emerge.
- Chapter 8 concentrates on the action research addressing RQ3.
- Chapter 9, finally, draws conclusions and discusses the managerial and theoretical implications, and possible further research.

CHAPTER FIVE:
THE IDENTIFICATION OF THE KNOWLEDGE MANAGEMENT CONFIGURATIONS

5.1 INTRODUCTION

As described in Chapter 4, this chapter aims at addressing RQ1, in the setting of consultancy companies.

Specifically research question 1 is:

What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge-intensive, innovative environments, and which performances are related to them?

RQ1.1. Which are the *functionalities of levers* fostering knowledge processes?

RQ1.2. Which *KM configurations* (in terms of ICT, organisation and management tools) are successful in terms of performances of the knowledge process?

RQ1.3. What are the effects of each *KM configuration of levers on performance?*

RQ1.4. Which *types of managed knowledge* characterise each configuration*?*

RQ1.5. Are the configurations of levers adopted in consultancy companies also valid in other knowledge-intensive industries?

In this chapter RQ1.1 to RQ1.4 will be addressed, while the validity of the outcomes in other knowledge-intensive industries (RQ1.5) will be analysed in Chapter 7. In more detail Chapter 5 aims to:

- Describe the processes through which knowledge, in its different forms, is acquired, transferred, shared, stored and retrieved; in so doing identifying the main learning behaviours and learning performances. The focus of the present research is highlighted in the grey box in figure 5.1. Although not the central issue of the present research, an outline of the role of capabilities and contingencies will be provided.

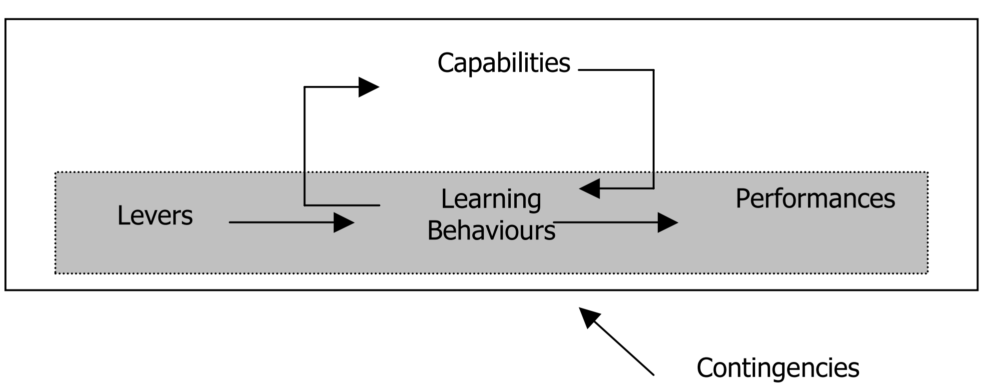


Figure 5.1: The CIMA model

- Identify which organisational mechanisms, Information and Communication Technologies (ICT) and managerial tools are implemented to influence knowledge processes. The theory and previous research related to CIMA, that addressed the issue of effectiveness of levers on behaviours, recommend the investigation of these three classes of enablers[1] of knowledge processes (Chapter 3) for further research.
- Identify if a discrete number of distinct overall approaches to knowledge management emerge, each characterised by a set of consistent levers (configuration of levers).

In order to address these issues, a process-based model for knowledge management is developed in the following sections. Such a model is a "conceptual" hypothesis (in the form of a framework) on the relationships between knowledge process, outcomes, and enablers. Results from the application of the model in eight case studies (all in consultancy companies) are used in the operationalisation of this framework. The explanation of empirical results through theory provides a validation of the framework and its operationalisation for the considered research setting, and allows the development of new insights into the existence and characteristics of knowledge management configurations.

In the following sections, the conceptual framework is described in Section 5.2, while the methodology is explained in Sections 5.3 and 5.4 in terms of research setting selection, investigation protocol and questionnaire. The main results are then discussed in Section 5.5 (enablers, performances and contingencies), and the emerging knowledge management configurations in 5.6. The explanation of the results through the theory (interpretation) is then reported in Section 5.7.

5.2 A PROCESS PERSPECTIVE FOR KNOWLEDGE MANAGEMENT

Analysis of the existing literature (Zack, 1999b) allows one to define knowledge management within a "process management" view (figure 5.2). Through the case studies, the model can be *operationalised*. Within this perspective, it is possible to define:

- *Knowledge processes*: the interrelated set of activities, by means of which, inputs – data, information, knowledge, are transformed into outputs – (new) knowledge. According to literature (e.g. Huber, 1991) three main activities can be identified, and labelled: acquisition, capitalisation and reuse, transfer and sharing of knowledge (figure 5.2).
  - *Acquisition of knowledge*, which includes <u>assimilation and creation.</u> Assimilation is the phase through which new knowledge is added to the knowledge base within the organisation. Such knowledge is not necessarily "socially new", that is new for society, but it could be new for the specific enterprise. Creation is addressed as an internal activity; the knowledge generated is completely new, coming from the innovative work of a member, a team, or an organisation, on a specific subject.

[1] In this thesis "enablers" has the same meaning of "levers".

- *Capitalisation and reuse of knowledge:* capitalisation is the activity of the process in which knowledge coming from different individuals and parts of the organisation is classified, integrated, and stored in the knowledge base (Meyer and Zack, 1996). In this phase, a knowledge unit gains value, proving it with a series of contexts, of links with different sections in order to enhance the possibilities of reuse. Reuse is a twofold activity, since it should support the research and identification (retrieval) of knowledge, and the application of knowledge in a new, different, context.
- *Transfer and sharing of knowledge:* an important feature of the "knowledge management process" is moving knowledge from where it is produced or created to where it is actually needed and used. This phase should support the extraction of specific knowledge, and the transfer of it when it is required.

- *Performances*: indicating the effects of the knowledge process on the operational process due to "knowledge at work". According to previous research (Chapter 3), the performances of knowledge management can be operationalised in terms of knowledge process performances (frequency of learning behaviours), people performances, and business performances.

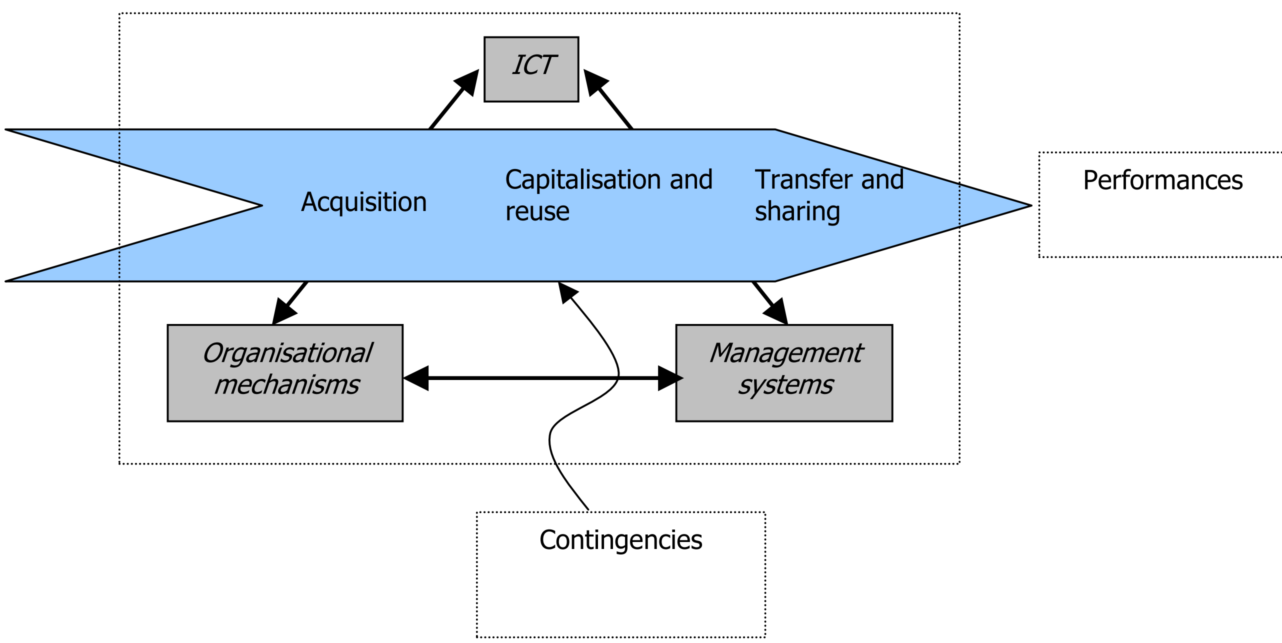


Figure 5.2: A process model for knowledge management

- *Levers* or *enablers*: tools and instruments that management can use to stimulate knowledge processes. According to the definition provided in Chapter 2, *knowledge management* is the process of designing, implementing, maintaining, and improving a system of levers (Information and Communication technologies, Management systems and Organisational mechanisms) through which an organisation fosters and focuses individual and group behaviours in terms of assimilation and generation, transfer and sharing, capitalisation and reuse of knowledge, in both tacit and explicit forms that are useful to the organisation. In figure 5.2, the three main classes of enablers, which are the object of the present research, are shown:

- ICT (e.g. document management, Data Base Management systems, search engines, communication technologies). ICT reflects all the technological applications that a company can use to acquire, capitalise and reuse, transfer and share, information and knowledge throughout the organisation. Such technologies can be implemented to directly enhance knowledge processes, or alternatively to improve business processes performances through indirectly facilitating information and knowledge flows. As reflected in the literature (Chapter 2), many technologies are considered relevant to knowledge management, although at different levels of analysis. In this thesis the level of analysis will be set at the "application level", level 7 of the ISO OSI classification (Gai et al. 1995) which focuses on the functionality of technology and on its use by the organisation.
- Managerial systems (e.g. performance management systems, management methods and tools, rewarding systems, training systems, human resource management policies) include all the tools, methodologies and practices that managers can implement within the organisation in order to manage resources (people, technologies, information, and finance) and, at the same time, foster knowledge processes.
- Organisational mechanisms (e.g. structures, roles, integration mechanisms) include all managerial decisions concerning allocation and coordination of resources, the definition of jobs and responsibilities, tasks, authorities, and responsibilities which can influence both the goal-oriented processes and the knowledge processes.

  It is very important to note that, although the first part of the analysis is aimed at investigating which specific classes of enablers are implemented by the case companies, the underpinning perspective is always a "systemic perspective": each enabler is not analysed as an isolated decision, but is assessed in relation with the other implemented enablers in order to investigate recurring sets of enablers.

- *Contingencies*: a set of variables which are external to the knowledge (management) process but influence it in terms of the effects of the levers on knowledge processes and their performances. Therefore, although such variables should be considered exogenous to the system, they should be taken into account when explaining the effects on the knowledge processes. Examples of such variables (Chapter 3) are degree of globalisation of activities, company strategy, human resource strategy and ICT culture.

Starting from this framework, some *propositions* that result from the described framework can be highlighted for this research, as noted in Chapter 4:

P.P.1 Different configurations of levers (ICT, organisational mechanisms and managerial systems) lead to different performances.

P.P.2 Different configurations of levers (ICT, organisational mechanisms, and managerial systems) support the management of different types of knowledge.

In this chapter, these preliminary propositions, still very open, will be refined in line with results from the explorative research in the eight consultancy companies.

5.3 THE RESEARCH SETTING

In Chapter 4, a description of the methodology chosen to address the research questions was provided, explaining how the multiple case studies fit the explorative purposes of RQ1 and RQ2. Three further issues have to be discussed in order to finalise the methodology design: the definition of the research setting, the investigation questionnaire, and the investigation protocol. The first issue is described in this section, while the remaining two will be dealt with in Section 5.4. It is important to highlight, as already noted in Chapter 4, that RQ1 and RQ2 will receive preliminary answers by conducting case studies using the same sample (consultancy companies) and will then be refined in another setting (telecom companies). In this section, the discussion concerns the first research setting (consultancy companies), explaining the main characteristics and the reasons of the selection. A brief description of each case is then provided in appendix 2.

The selection of companies for the case studies has been driven by three main criteria:

A. *Coherence with research questions purposes*. The companies involved are *knowledge-intensive*, as knowledge is the essential asset to carry out their work, then they should be *innovative* (in particular *inter-project-based*).
B. *Focus on configurations*. In Chapter 4, it was outlined that one of the open issues from previous research was that the companies involved in the preliminary investigations had shown different levels of awareness of knowledge management (some of them had developed specific projects, in others, KM was an emergent approach). In this thesis, the initial investigation concerns companies where knowledge management practices are rather consolidated and successful, in order to determine their configurations. The research setting is focused on *professional services organisations* that, due to their business, have dealt with KM for several years, and been *successful* in their business performances. This allows the derivation of successful knowledge management configurations.
C. *Practicalities of the investigation*. The companies involved in the sample manage *dispersed* projects: in these cases, knowledge management is a really critical and relevant issue in enhancing knowledge processes, which otherwise would not be supported (Quagli, 2001). Moreover, projects where the *customer is external* have been considered, as they are easier to identify within the organisation.

In the following discussion, a brief description of the characteristics of the research setting, and of the reasons for this selection, is provided:

Knowledge-intensive companies

As the research focus is on knowledge processes, companies involved should rely on knowledge as a strategic asset. In order to facilitate the identification of knowledge activities, the analysis has focused on knowledge-intensive processes. In particular, the first step of the explorative research developed in this thesis addresses eight management consulting companies. They represent a very significant case of knowledge-intensive companies, as knowledge processes are core activities for their business process, since they have direct effects on business performances, such as costs and quality of the solution provided to customers.

Focus on intra and inter-project learning

In the CIMA work (Chapter 3), the unit of analysis was set as a family of projects (where by family is meant a group of projects with the same market, or approaching the same industry, or dealing with the same problem, or developing a different version of the same family of products). In the sample of the consultancy companies, the classification of projects according to certain dimensions (industry, customer, discipline) has been considered to be one of the variables to manage knowledge in an inter-project environment. The assumption underpinning the focus on inter-project learning is that it is extremely important for the business where companies are operating. Every project presents a degree of innovation related to its output or process (De Maio et al. 1994); but experience and learning from other projects can support managers in approaching present ones.

Professional service organisations

According to Sverlinger (2000), professional services organisations can be discussed using an input-output model consisting of four elements: 1) resources; 2) information inputs; 3) the service process and 4) output or value to the client. Resources include human capital (Sveiby, 1996) in terms of employees' competencies, which involve the capacity to act professionally in a wide variety of situations, and structural capital which supports the business process as it is carried out (operational supports systems; storage of previous projects). Also, information input can be treated as a capital resource (Sverlinger, 2000). Concerning the output, consultants can be asked by the customer to provide different "products" as an output of the collaboration: a) *problem setting and scenario,* where the consultant is asked to provide possible "to be" situations according to the strategies and organisation of the customer; b) *methodology*, where the consultant provides a methodology to support the customer in making decision (problem setting and problem solving); c) *solution,* where the consultant provides the effective IT or organisational design. In all the cases, knowledge is the core output of the process (Sverlinger, 2000; Sadler, 2001; Werr and Stjiernberg, 2001; Quagli, 2001).

Figure 5.3 illustrates a framework for the business processes of consultancy companies. According to Maister (1982), there are basically three major processes in the delivery of consultancy companies:

- *Client relations,* which involve both the activities of preliminary interaction with the customer in order to understand the problem, acquire new assignments, and set the specifications; and of management of the relationship with the customer during the performance of the project itself.
- *Project management,* which involves both the process of development of the solution, and the project management activities (coordination with other consultants and public authorities).

Performing the detailed professional tasks, which is the real "production phase", when the solution has been developed, and it has to be implemented.

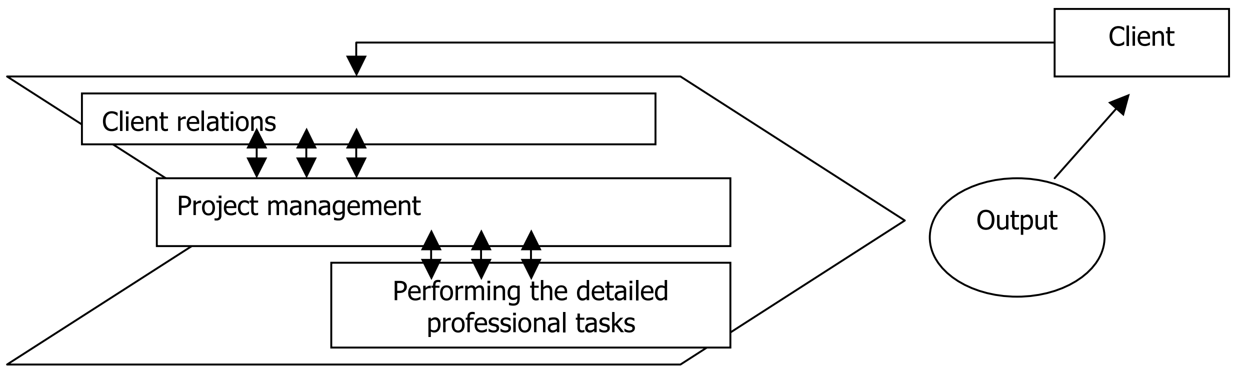


Figure 5.3: The business process of consultancy companies

Focus on successful companies

The analysis involved eight consultancy companies, selected because they were successful in their business performances (compared with their competitors). The main assumption underpinning the selection of these companies was that if they are successful companies, and knowledge process is their core activity, then the knowledge processes should be being well managed. The analysis on the levers implemented by such companies should lead to the identification of successful configurations.

Focus on dispersed projects

Literature especially emphasises the role of ICT in the case of dispersed projects (Wijnhoven, 1999; Quagli, 2001), for increasing communication among members of teams who are not co-located. This contingent factor will be considered in the choice of sample companies. Dispersed projects can be considered in terms of two interpretations:

- The actors involved in the project are dispersed. This means that either a formal team exists, but is spread across several company locations; or a formal team does not exist, but the expertise necessary to carry out the activities of the project is not available in a single location (suppliers, customers, experts…).
- The actors involved in previous projects that are related to the current one, or related subprojects, are dispersed, while the actors involved in the current project may or may not be dispersed. This situation could be considered as a particular case of the previous one (experts to be involved in the project are not available at the same location), but it seems particularly important to highlight it as a separate issue. The reason is twofold: on the one hand it directly links to inter-project learning, on the other, it is very common, in a global environment, that related projects are carried out in different locations all over the world.

The selection of dispersed projects allows one to address, in more detail, the role of ICT as it is assumed that their functionalities particularly facilitate knowledge management in this context (Zack, 1999a).

Focus on projects where the customer is external

According to De Maio et al. (1994), projects can be classified as in figure 5.4.

		Specifications are set at the beginning of the project	
		Yes	no
Customer of the project	External	Consulting projects	Product Innovation projects
	Internal	IT projects	Reengineering projects

Figure 5.4: Classification of projects (adapted from De Maio et al. 1994, p.34)

According to this classification, projects can have internal customers (as IT or reengineering projects) where the boundaries of the project itself, in terms of duration and scope, are not easy to define. Alternatively, the externality of the customer facilitates the identification of the temporal boundaries (start and end of the project) and organisational boundaries (in terms of the impact of the project). Similarly, project specifications can be known in advance (usually included in a form of agreement or contract), or have to be interpreted and set (this is the case with most Product Innovation projects). In order to simplify the analysis, my research has concentrated on "external customer projects". This helps in defining the boundaries of the project itself, and therefore in identifying the efforts of the organisation to relate knowledge coming from different projects. Moreover, this type of projects is considerably more common than the ones with internal customer in the context of consultancy companies.

5.4 THE INVESTIGATION FRAMEWORK

In order to finalise the description of the methodology design in consultancy companies (addressing RQ1 and RQ2), it is necessary to describe the investigation framework in terms of the questionnaire and investigation protocol. As indicated in Chapter 4, the goal of the investigation is mainly explorative in terms of the configuration of levers implemented (ICT, organisational mechanisms and managerial systems), their effects and contingencies (RQ1), and in terms of associations between configurations and innovation strategies (explored as contingencies) (RQ2).

The case studies have been carried out through interviews with project managers from the consultancy companies. The case study protocol was organised as follows:

- The first contact with the company has been by phone, fax or email. In order to initiate a first appointment, a brief letter outlining the goals of the research project was sent to the company.
- An interview was first arranged with the person responsible for the Organisation unit, and then with the responsible ICT person and one project manager. This approach facilitated the analysis of the case study, both from the knowledge process (involving the organisation and ICT) and from the business process (project manager) points of view.
- At least two researchers carried out each interview.
- All the interviews were carried out using a semi-structured questionnaire consisting of four sections: general strategy of the company and contingencies (to address the issue of contingencies and innovation strategies); ICT infrastructure (to address ICT functionalities and structure); description of business processes (to map relevant knowledge and organisation of business processes); and description of the knowledge management process (to map which enablers are implemented and used in every knowledge process activity, and the performances of the knowledge process). All the

sections were used with all interviewees, so that the reliability of information collected could be checked (appendix 3). Each question was accompanied by a list of "prompts" facilitating the interpretation of the meanings of questions for the specific research.

- A reporting tool was attached to each section of the questionnaire in order to facilitate the organisation of collected information and the analysis of results. During each interview, one of the two researchers led the compilation of the semi-structured section of the questionnaire, while the second researcher checked if all the information needed to complete the reporting tool emerged from the interviews.
- Each interview lasted about two hours.

According to Yin (1994), four elements should be considered and evaluated when conducting case studies:

- CONSTRUCT VALIDITY: this requires an objective operationalisation of the variables of the underpinning model. One of the main critiques to case study research is the possible extent of subjectivity. In this research, in order to ensure construct validity, each question in the questionnaire was supported by a set of prompts in order to create a common understanding of possible answers. Furthermore, the reporting schemes for each group of questions, helped to make explicit the purpose of such questions and the required information.
- INTERNAL VALIDITY: the internal validity of the methodology is related to the definition of objective causal links among variables. The analysis has been carried out in multiple cases, and the propositions have been refined as shown in figure 5.5.

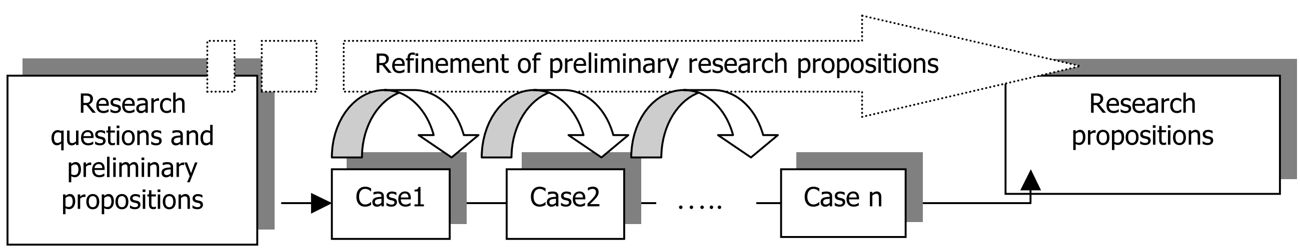


Figure 5.5: The development of research propositions

Through the use of multiple cases, the preliminary propositions concerning the configurations of levers (Chapter 5), and the alignment between strategy and configurations (Chapter 6), were refined. These will, in turn, be further refined through longitudinal case studies (Chapter 7). The continuous refinement of propositions allows the model to be internally validated.

- EXTERNAL VALIDITY: the external validity indicates the applicability and generalisability of results. First of all, the research setting has been selected in order to involve companies where the knowledge process is extremely relevant to achieving their expected business results. Companies will have a good familiarity and a good level of formalisation with knowledge processes. Following this, the framework and research propositions will be applied in two further case studies in order to investigate the possibility of generalising the results to other knowledge-intensive professional organisations.

- RELIABILITY OF THE RESEARCH: The reliability of the questionnaire is related to the objectivity of meaning of questions and the relative answers. The availability of prompts for each question contributes to the reliability. Moreover, discussions with other researchers applying the same investigation framework in other industries (Corso et al. 2002) have been carried out in order to validate the process and to highlight those issues that are specific to the consultancy industry.

5.5 THE OPERATIONALISATION OF THE FRAMEWORK

The first major result from the case studies concerns the operationalisation of the model as outlined in Section 5.2. In the following sections, the different variables will be discussed.

5.5.1 The enablers

All the companies involved in the explorative research have implemented different enablers to foster knowledge processes. In this particular sample (the eight consultancy companies), knowledge processes represent essential processes for the survival of the companies since knowledge can be considered as the main "product" sold by such organisations. Although all are aware of the importance of acquisition, capitalisation, reuse, transfer and the sharing of knowledge, they address the issue by relying on differing technological, organisational and managerial functionalities and solutions. In figure 5.6, the adoption of different levers by companies in the sample is represented.

ICT

Firstly, companies use ICT primarily to enhance two phases of the knowledge process: transfer and sharing, and capitalisation and reuse.

A. Concerning solutions that support *knowledge transfer and sharing*, technologies can be classified according to how the actors interacting though technology are involved in the decisions:

   - Some companies (A, E, and G) implement ICT in order to enhance *communication*. Such technology aims at connecting people simply for knowledge transfer without supporting any joint work. Typical technologies are videoconferencing, telecommunication tools, and call meetings. Teams use ICT to communicate decisions already taken or solutions developed, and most of the time the technology enhances one-way knowledge transfer.

   - ICT can be used to enhance *collaboration* (B, E, F, G, and H). In this situation, the technology not only supports knowledge transfer but also joint work and knowledge sharing. The ICT are usually implemented to facilitate the development of solutions, the sharing of knowledge, joint decision-taking (problem setting and problem solving). Examples are groupware, virtual team working, Internet based tools for collaboration, portals, agents, and workflow systems.

   A common characteristic of these technologies is that, in a certain way, they aim to recreate the context that is missing in the situation of dispersed workers. The possibility of asking for information, or solving a problem together, which is an implicit characteristic of co-located workers, has to be substituted for in the case of dispersed teams. Technology, as widely discussed in literature (Stein and Zwass, 1995; Croasdell, 1997; Berini, 2000), can help in creating the virtual environment needed for communication/collaboration throughout the organisation.

B. Other technological solutions support *knowledge capitalisation and reuse* (supporting the categorisation, storage, retrieval, and application of knowledge). Such ICT solutions can be classified according to the "stored knowledge":

- ICT for *storing of solutions*, which means, in consultancy companies (B, D, E, F, and H), the storing of cases. Case classification is extremely easy, objective, and well recognised throughout the organisation. As an example, one of the companies classified knowledge according to the specialisation (organisational unit involved), industry and market. Examples of such technologies include best practice archives, lesson learnt archives, databases, expert systems, and EDMS.

Levers	Companies→	A	B	C	D	E	F	G	H
ICT	***ICT for transfer and sharing***								
	Communication	X				X		X	
	Collaboration		X			X	X	X	X
	ICT for capitalisation and reuse								
	Solutions Standard.		X		X	X	X		X
	Processes Standard.		X	X			X		
Management systems	Analysis Systems	X			X	X			X
	Standard Methodologies		X	X			X		X
	Performance Measur. Systems	X	X					X	
	Job Rotation				X	X			X
	Mentoring	X				X		X	
	Training		X				X		
Organisational Mechanisms	Standardise KM Practices		X				X		
	Own KM at a management Level				X	X			X
	To diffuse Responsibility	X		X				X	

Figure 5.6: Operationalisation of knowledge management levers in the sample

- ICT for *storing standardised processes* provides knowledge concerning the procedures adopted in performing the consultancy work for companies (B, C, and F). The dimensions of the classification are not objective throughout the organisation and are complex. Therefore, the categorisation and retrieval process relies, to an extent, on articulated algorithms. Examples of such technologies are data warehouse, data mining, and databases.

When storage solutions are adopted, the technological level (in terms of availability of technological means for employees) and culture (in terms of technological familiarity of employees) of the company are usually extremely high (achieved through education and technological studies), especially when considering young consultants. Each consultant can access the Intranet according to specific security rules through their own ID even from a mobile (sometimes wireless) position. In some cases (companies B and F), the companies that have adopted ICT to store solutions in order to facilitate retrieval of knowledge stored in databases have even adopted push technologies (i.e. intelligent and mobile agents).

Management systems

Consultancy companies in the sample generally consider Management Systems as both methodologies to facilitate the analysis and the reflection on cases, and as human resources policies that facilitate the development of knowledge. This is explained in more detail below:

- *Analysis Systems* (A, D, E, H) Such tools allow the capture of new knowledge from daily work, often leaving it in a tacit format. They are usually implemented as consolidated procedures and methodologies to assist people in reflecting on their daily activities and so contributing to the knowledge base. Examples of such systems include After Action Review, Learning Histories and Peer Assist.
- *Standard Methodology* (B, C, F, H): a set of tools, such as Case Based Reasoning, Best Practices, Lesson Learned Archives, which facilitates a strong standardisation in the way in which people work. Such tools try to strongly standardise the inputs used in their processes in order to achieve a high level of standardisation in the desired outputs. Usually such methodologies are related to the storage uses of ICT. Standardised and codified knowledge can then be easily stored in databases.
- *Performance Measurement Systems* (A, B, G): the definition of a set of "criteria" for measuring the quality and the quantity of access to the knowledge management system. Often connected to incentives systems, performance measurements are usually related to the business process performance, and, only in few cases, they are directly associated to the knowledge management process.
- *Job Rotation (D, E, H)*: by rotating jobs, the knowledge manager role for a specific area is each year charged to a different person, changing the area monitored by each manager. Such a technique is used with the purpose of increasing the global vision of the community of knowledge mangers, also reducing the risk of spin-off.
- *Mentoring and Training* (A, B, E, F, G): as part of the "human resource strategy", a company can decide to adopt a "mentoring" technique, focusing on the one-to-one training; or on the "training courses" technique that focuses on the wide diffusion of the knowledge among workers. Training courses, in particular, are used as a method to transfer and diffuse knowledge, but also, for teachers, to reflect on past experiences.

Organisational mechanisms

Organisational mechanisms refer to the definition of specific organisational structures or roles within the company. Three approaches emerged from the analysis:

- *To standardise knowledge management practices* (B, F). This occurs where a *specialist unit* (with specialist roles) has been appointed within the organisation with the responsibility for knowledge management. Some companies have specialised staff for knowledge management, usually organised in centralised and localised units (according to the extent of globalisation of activities). Such units are in charge of abstracting and generalising knowledge from cases, and transferring the lessons learnt to consultants according to the supposed relevance to their work. In some companies, such knowledge managers are also in charge of identifying the relevant knowledge to store. In one case in particular, they store a document describing a case according to the peculiarity of the document, the typology of the customer (new, large…), and the level of reusability of the document itself.
- *To diffuse responsibility for knowledge management* (A, C, G): most members of the organisations, besides their operative roles, have *a dual role as knowledge professional* within the global knowledge management process. This is the opposite situation to the situation described above: knowledge management processes overlap the goal-oriented processes and everyone in the organisation has to perform such activities alongside their business activities.
- *Knowledge Management is owned at a management level*. (D, E, H) This is an intermediate situation: middle management is in charge of controlling and performing the knowledge management process: establishing mechanisms, tools, strategies and techniques for the process. They have a "dual role", since they work in the operational process and, concurrently, they establish a community for the management of knowledge, whereas all the other consultants are involved only in business process activities. The latter participate in the knowledge processes at only two stages: providing evidence of their experiences to managers, and accessing the built-up knowledge base.

The technologies, managerial methodologies, and organisational structures and roles, as implemented by the consultancy companies (for a more specific description of the case studies see appendix 2) in order to stimulate knowledge processes, have been classified according to the functionality that they support. An overview is provided in figure 5.6. The next step, in order to answer RQ1, is to investigate if the similar functionalities of levers characterise a number of "configurations". However, in order to complete the operationalisation of the framework, the performances and contingencies in the sample will first be described (Sections 5.5.2 and 5.5.3).

5.5.2 The performances

The explorative research has also aimed to investigate the performances of knowledge management. The *effectiveness* of knowledge management can be measured at three levels of analysis. In figure 5.7, the two main types of process are highlighted. Business processes are the main processes of a company in terms of the effect on corporate results. Knowledge processes, on the other hand, aim at acquiring, transferring and sharing, storing, and reusing knowledge, according to different goals and practices in order to support business processes. Based on this distinction, and using the definition of knowledge management provided in Chapter 2, the performances of knowledge management can be operationalised as follows:

1. *Knowledge process effectiveness* (KPE) represents the effectiveness of enablers in stimulating knowledge processes in terms of acquisition and generation, capitalisation and reuse, transfer and sharing of knowledge. Results from previous research have shown that levers are related to the *frequency of learning behaviours* (Chapter 3), which is now assumed to be a measure of the effects of the configuration of levers on the knowledge process. This approach to measuring the KPE has two prerequisites: the first is a clear identification of the unit of analysis in terms of the groups of people involved in the process. In the case of consultancy companies, as described in 5.3, the focus of the analysis in this thesis is project teams. The second requires a choice of measurement scale: in this work, the five point Likert scale (1:not frequent at all- 5: very frequent) has been adopted. The learning behaviours that have been measured, are listed below:

   B1: Individuals use the organisation's strategic goals and objectives to focus and prioritise their improvement and learning activities.

   B2: Individuals use their own activities as opportunities to develop knowledge.

   B3: Individuals use part of available time/resources to learn.

   B4: Individuals integrate knowledge within all the different phases of the project in which they are involved.

   B5: Individuals transfer knowledge among different projects.

   B6: Individuals abstract knowledge from experience, and generalise it for application on new projects.

   B7: Individuals embed knowledge, making the knowledge available to others by incorporating it in vehicles that can be more widely disseminated and retained over time.

   B8: People try to assimilate and internalise knowledge from external sources.

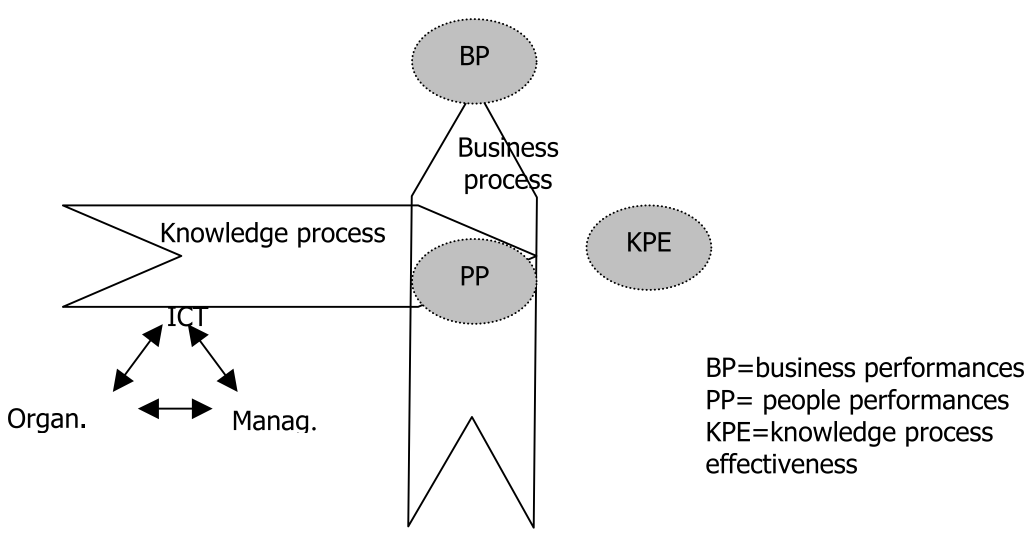


Figure 5.7: The relationship among different levels of performances

2. *People performance* (PP). People performances are related to an individual's position and interaction with other individuals within the company. According to empirical analysis, in many situations, the existence of knowledge management practices has improved the quality of working life. Increased communication and collaboration, and the possibility of generating knowledge and contributing to the development of the company knowledge base, were indicated by managers as essential in improving the work satisfaction, self-esteem, and the sense of belonging, and so reducing labour turnover of consultants.
3. *Process and Business performances (BP)*, represent the effects of the knowledge management system on the performance of the company. The companies in the sample are all successful in terms of corporate performance. Nevertheless, when addressing the specific questions, managers indicated different particular performance dimensions as responsible for their success.

Performance	Company→	A	B	C	D	E	F	G	H
Knowledge process effectiveness	B1								
	B2	X		X		X		X	
	B3	X		X				X	
	B4	X	X	X	X	X	X	X	X
	B5	X	X		X	X	X		X
	B6	X							
	B7		X		X		X		X
	B8	X		X		X	X	X	
		A	B	C	D	E	F	G	H
People performances	Better use of time		X		X	X	X		X
	Work satisfaction	X		X	X	X		X	X
	Self esteem	X		X				X	
	Sense of belonging.	X	X		X	X	X	X	X
	Reduction of labour turnover	X		X				X	
		A	B	C	D	E	F	G	H
Business performances	Time to Market		X	X			X		X
	Efficiency		X		X		X		X
	Customisation and customer satisfact.	X		X		X		X	
	Lesser spin-off Risks		X		X	X	X		X

Figure 5.8: The business performances of consulting companies

In figure 5.8, the synoptic table summarises the results concerning the three classes of performances. In terms of knowledge process effectiveness, the most frequent behaviours (4 and 5 on the Likert scale) found within the project team are reported. A more detailed analysis will be developed in the next section, in order to check if groups of behaviours are associated with configurations of levers, and taking into consideration other roles than consultants in the project team. In fact, while carrying out the case studies, it emerged that beyond the project team, other roles (such as specialists and managers) are involved in knowledge management activities, and therefore they also show behaviours. Following this, people performances and business performances are also reported.

Considering figure 5.8, it is possible to recognise that some companies have similar results in terms of the dimensions of performance. For example, considering knowledge process effectiveness, some companies (A, C, G) are focused on knowledge generation (B2 and B3) while others (B, D, F, H) are focused on knowledge embedment (B7). Similarly, when considering people performances, most companies report good results in terms of good work satisfaction and a sense of belonging, but only a few (A, C, G) saw a reduction in staff turnover. Finally, concerning business performances, some companies are more focused on improving time-to-market and efficiency (B, F, H), while others (A, C, E, G) are focused on customisation and customer satisfaction.

In Sections 5.6, the results will be further analysed in terms of configurations. Analysing the functionalities of the levers reported in figure 5.6, knowledge management configurations will be described, and then associated with performances.

5.5.3 The contingencies

Some contingencies have been analysed in order to see which were the most relevant for the specific set of companies, and influenced the adoption of a certain knowledge management configuration. In particular, the contingencies have been investigated as the main characteristics of a company, asking respondents to specify which ones are seen as the most critical in terms of effects on knowledge processes. In the questionnaire, the contingencies identified were:

1. Size of the company: in terms of turnover and number of employees.
2. Level of competition in the industry: in terms of number of competitors and position of the company (leader or follower).
3. Locality: in terms of country.
4. Level of dispersion: in terms of market and dispersion of activities.
5. Level of complexity of the solution and of the project. The complexity has been operationalised in terms of portfolio complexity (in terms of service variety), product/service complexity (in terms of number of subcontractors to manage, number of people involved in the team, skills required, technologies involved…), and system complexity (in terms of relationship with the customer).
6. Ownership and inter-firm relations.
7. Labour churn: in terms of turbulence in the labour market.

From the interviews in the consultancy companies, it was found that managers especially highlighted three of the contingent variables as influencing the knowledge (management) processes, and these are summarised below and in figure 5.9.

Contingencies	Company→	A	B	C	D	E	F	G	H
Degree of Dispersion	High	X	X			X	X	X	
	Medium			X	X				X
	Low								
Vertical Integration	Strategic consulting	X			X	X		X	
	Complete service			X	X				X
	Operative consulting		X				X		
Labour Churn	High		X		X		X		X

Figure 5.9: The contingent situation of the companies involved in the study

- *Degree of dispersion*: all the companies had dispersed activities and most of them have a global market. Such dispersion emphasises the need for acquisition, storage and reuse, share and transfer of knowledge, in a network of competencies. Two reasons have been given by managers: first of all to improve costs and the times of the projects carried out, and the quality of solutions/support delivered through accessing knowledge developed in other projects. Secondly, in order to foster a sense of belonging in the consultants who otherwise would lose reference points.
- *Level of complexity of the solution and of the project:* this variable has been interpreted by managers of the consultancy companies as related to their *vertical integration*. Some companies (A, D, E, G) in the sample are focused on strategic consultation in terms of development of organisational and management solutions customised to the customer needs (figure 5.9). Other companies (B, F) are focused on operative consulting, as they generally support the implementation of technical solutions enabling operational processes (i.e. ERP systems). Finally, other companies (C, D, H) deliver a complete service, from strategic analysis to implementation. In discussions with managers it emerged that the requirements, in terms of knowledge (management) processes, for these contingent situations are different: managers of strategic consulting companies indicated that the key ability of the consultants is to "develop innovative and customised solutions with the minimum time and costs". However, managers of operative consultants stressed the "reuse of past solutions in order to provide a solution at the minimum time and costs".

  At the same time, also the strategic priorities of the companies in the two contingent situations seemed to be different: strategic consulting companies focus on "customisation and innovativeness of solutions", operative consulting companies focus on "efficiency and time to market" (figure 5.9). This contingent variable, therefore, can also be analysed in more detail by referring to innovation strategies (see Chapter 6). In order to facilitate the interpretation of this contingent variable, figure 5.10 summarises the strategic priorities, the vertical integration and the critical issue from the knowledge processes point of view, as expressed by managers during the interviews.
- *Labour churn*: the turbulence in labour market and the turnover in human resources (churn) are considered to be a third driving force for knowledge management. Many companies have stressed

the importance of storing knowledge through an ICT solution, in order to prevent knowledge loss as a result of personnel turnover.

Company	Business performances	Vertical integration	Critical issues for knowledge management
A	Customisation and customer satisfact. Innovation of the solution	Strategic Consulting	Development innovative solutions for customers generating knowledge
B	Time to Market Efficiency Lesser spin-off Risks	Operative Consulting	Reuse of solutions
C	Time to Market Customis. and customer satisfact. Innovation	Complete Service	Development innovative solutions for customers generating knowledge
D	Efficiency Lesser spin-off Risks	Strategic Consulting	Capture knowledge from consultants and develop the knowledge base
E	Customisation and customer satisfact. Innovation of the solution Lesser spin-off Risks	Strategic Consulting	Development of specialised competencies for new customers
F	Time to Market Efficiency Lesser spin-off Risks	Operative consulting	Reuse of solutions
G	Customisation and customer satisfact. Innovation of the solution	Strategic consulting	Development innovative solutions for customers generating knowledge
H	Time to Market Efficiency Lesser spin-off Risks	Complete service	Capture knowledge from consultants and develop the knowledge base

Figure 5.10: Vertical integration of companies and the relationship with business and knowledge management priorities

As in the case of performances, a more detailed analysis of companies' contingencies will be developed according to emergent configurations (Section 5.6). More specifically, through the functionalities of levers the configurations will be detected and, then, the main characteristics in terms of performance and contingencies will be discussed. For the contingencies, the focus will be on the three contingent variables identified in the interviews.

5.6 THE IDENTIFICATION OF KNOWLEDGE MANAGEMENT CONFIGURATIONS OF CONSULTANCY COMPANIES

From the analysis of the functionalities of levers, three main configurations for knowledge management emerge from empirical case studies. These approaches can also be described according to the forms of the levers implemented to realise the functionalities, the associated performances and contingencies, and the types of knowledge enabled. In the following subsections, a brief description of the configurations is provided, highlighting the functionalities and forms of levers, the performances (with particular attention to the knowledge management effectiveness), and finally the types of knowledge. In terms of the contingencies, a more detailed analysis will be developed in Chapter 6 and 7, in addressing the second research question.

5.6.1 The three approaches: functionalities and forms of levers

According to the functionalities of levers identified in Section 5.5 and represented in figure 5.6, three configurations emerge. Each configuration is briefly described, associating to functionalities also the forms of levers implemented to realise them.

Focus on standard KM practices (B, F)

Companies adopting this configuration try to standardise and support knowledge management process mainly through centralising Knowledge Management responsibility and the establishment of a new unit.

The two main duties of this unit are:

- Developing and establishing methods and tools to support and enhance the knowledge management process within the organisation.
- Supporting and assuring coherence of almost every activity of the process: acquisition, capitalisation and reuse, transfer and sharing.

Knowledge management is viewed as a new role. Organisations appoint Chief Knowledge Officers (CKO) whose full-time task is to define ICT support, managerial tools and organisation mechanisms that are to be used for knowledge management.

Centralised units and CKOs are generally also responsible for assimilation and integration of knowledge coming from external sources. Rotation of the knowledge management task is generally unacceptable since continuity and specialisation, rather than width, are seen as the basic values. For this reason, people appointed as knowledge professionals follow a new career path.

Such a solution gives a strong visibility and structure as knowledge management is perceived as a new role within the organisation.

Contributing to standardisation, ICT is used for storing and supporting solutions, and standard procedures and methodologies. In terms of management tools, companies adopting this configuration normally adopt a standard methodology: every worker within the organisation should give a standard contribution to the knowledge management system.

Communication among members within the organisation is asynchronous and distant, rather than synchronous and co-located. Team working is performed in a virtual space where people are forced to use standardised practices. The effort is put into enhancing the process of "externalisation", transforming knowledge from tacit into explicit, and transferring it from the individual to the organisational level. Constant updating and careful use of "standard methodologies", thus plays a key role in the Knowledge Management process.

Organisations develop databases and a computer-based system designed to support the management of explicit knowledge. The relevant feature of this solution is that it supports the building and operation of a virtual organisation, since every member, regardless of physical location, can not only search and retrieve, but also capture and store, specific knowledge. Spatial and temporal boundaries are outdated. An internal network, usually an Intranet, is used as backbone for the communication and transfer of documents. A system of access management allows the knowledge base to be protected from outside access.

Focus on hierarchical KM practices (D, E, H)

Companies D, E, and H, in the sample, have adopted a different configuration for knowledge management Knowledge is managed at a high level of the hierarchy, by building a "community of partners" (Wenger and Snyder, 2000). Partners are responsible for the control and management of knowledge that is perceived to be one of the key sources of power and competitive advantage. With their dual role, of project managers and knowledge owners, partners support and control the process of generation, retrieving and capitalisation of knowledge, from and to the specific projects. At the same time, they are gatekeepers of knowledge assimilation from other parts of the group or from external sources.

A clear division is therefore made between partners, who are full members of the "knowledge community" and therefore responsible for management of corporate knowledge, and the rest of the organisation who learn from their own experiences or from partners' contingent advises.

Communication among process owners is both synchronous and asynchronous, supporting the building of a "virtual community" among partners. They exchange and share tacit or articulated knowledge, while keeping it tacit in front of the rest of the organisation. Knowledge is captured from the workers using managerial tools such as "knowledge elicitation interviews" (Geiwitz et al., 1990), "learning histories" (Roth and Kleiner, 1999).

The physical location of the process owners is not important since they build their community based on sharing within a "virtual community", creating a virtual space in which the teamworking is performed jointly. According to Kotnour and Proctor (1996), workers in a strategic community are connected by knowledge management tools, whereas a traditional community is connected by shared responsibility for "what is managed" in a process. The use of electronic devices to connect non co-located teams is vital in order to achieve an actual "virtual organisation" (Venkatraman and Henderson, 1998).

Such a solution relies on the use of an internal network, often an Intranet, which allows people from distant locations to be connected. Every member of the community can record new information or knowledge and, regardless of the physical location, another member can retrieve it. Each member within the community is charged with monitoring and to controlling a specific subject. After an established period of time, they enact "knowledge job rotation", changing the practise each member has to control. Such a system allows the organisation to reduce the risk and impact of a possible spin-off of a member of the community, sharing among the whole community the full set of knowledge.

Focus on diffused KM practices (A, C, G)

Companies A, C and G in the sample adopted a third configuration aimed at diffusing the responsibility for knowledge management throughout the organisation to workers involved in the operational processes. The underpinning idea is that every person should act as a knowledge engineer, developing and improving knowledge related to the specific operational process in which they are involved. In this way a person is responsible for capturing, capitalising, sharing and reusing knowledge, based on insights and experiences gained during the work. Everyone is therefore assigned a "dual role":

- On the one hand, a worker is involved in the operational process, performing operations according to their role.
- On the other hand, the same worker should capitalise and store what they have learnt, making explicit the result of individual learning.

From a management tool viewpoint, the focus is on involving every member of the organisation in the process, through transparent and diffuse use of Performance Measurement Systems, also focused on knowledge activities, and analysis systems such as "After Action Reviews", "Peer Assistance", "Learning Histories", to foster learning and sharing of experience. Human resource strategy is based on "one-to-one training", with mentoring, on the job training, and other techniques which do not necessarily allow the organisation to achieve a high growth rate but which allow to achieve a high degree of development of human resource skills.

This kind of approach is based on synchronous communication methods: whenever possible people are "co-located" in order to achieve a richer and better co-ordination. These organisations support "co-located" work within ad-hoc teams, and provide workers with mediums to support wireless communication and physical rooms for team working.

ICT is also used to overcome space barriers (i.e. distance problems) to synchronous communication when necessary.

The effectiveness of this approach relies on the ability of the enterprise to identify and move experts around, creating teams that fit the problem in hand. This kind of approach can achieve optimal performance in terms of customisation and customer satisfaction. Its main disadvantage is that the risk associated with labour turnover is very high, since people within the organisation are the true sources of knowledge.

In figure 5.11, the main functionalities of levers associated with each configuration are summarised.

In figure 5.12, a list of the organisational, technological and managerial solutions (forms) adopted by the companies to is represented. In particular, the functionalities of organisational mechanisms can be realised through organisation structure and roles (Mintzberg, 1985), the functionalities of ICT through technical solutions (Zack, 1999b), and the functionalities of managerial systems through managerial tools and methodologies (DiBella et al., 1996).

The forms of levers shown in figure 5.12 represent those organisational, technical and managerial solutions implemented by the companies in the sample to realise the functionalities listed in figure 5.11. It is important to note that this list is not exhaustive as the functionalities can also be realised by new forms. Recent innovations in the area of ICT and management clearly show that the number of practices is extremely large and increasing (Chapter 2). At the same time, a relevant advantage of interpreting the configurations in terms of forms is the adherence with the reality and the understanding by the interviewed managers. The functionalities are in fact somewhat general and abstract, while the forms represent specific and concrete choices made by managers.

Configurations **Levers**	**Focus on standard KM practices**	**Focus on hierarchical KM practices**	**Focus on diffused KM practices**
Organisation mechanisms	Standardisation of KM practices	Direct supervision of KM process. To own the responsibility of KM at a management level	Involvement of all people throughout the organisation in knowledge management activities.
ICT	Storing *solutions and procedures* (DB and Intranet) *Asynchronous* and *distant* communication (Intranet)	*Synchronous communication* for managers and *asynchronous communication* for workers. *Virtual community* only for managers ICT to *make explicit* knowledge of workers.	ICT mainly supports *synchronous* communication and collaboration
Managerial systems	*Specialisation of people* over time (i.e. no job rotation, carreer path…) Managerial tools to develop also knowledge professionals as *specialists* Managerial tools to *standardise knowledge practices* (i.e. procedures)	Managerial tools to *assimilate "lessons learned"* from workers *Not specialisation* for workers	Operational *activities have to become opportunities to learn,* so managerial tools have to provide occasions for learning *during* activities. People should be *evaluated and rewarded* also according to learning activities

Figure 5.11:Synoptic table of functionalities of the levers in the configurations

Configuration **Levers**	**Focus on standard KM practices**	**Focus on hierarchical KM practices**	**Focus on diffused KM practices**
Organisation structure and roles	*Specialised knowledge management unit* made of a restricted group of people Chief Knowledge Officer	Knowledge management activities are executed by partners who constitute a strategic community	People throughout the organisation play a dual role in knowledge and operational processes. No specialist role for KM is appointed. Definition of gatekeepers
Technical solutions	Integrated system for storing cases and practices (Lotus Notes) Push technologies	Intranet, forum on line, groupware, archives, videoconferences, CD	Yellow pages on line, forum, chat, virtual communities, groupware, collaboration tools.
Managerial tools	After action review, videoconference, brainstorming, peer assist, case based reasoning, best practices, lesson learned, learning history training courses.	After action reviews, brainstorming, peer assist, expert list, yellow pages, training need analysis, practise meeting, workshop, forum, mentoring, and knowledge elicitation review training courses.	After action reviews, contacts with universities and participation in seminars, meeting space, informal mechanisms, expert list, yellow pages, case based reasoning.

Figure 5.12: The "forms" of implemented levers to realise functionalities

5.6.2 Performances of the configurations

In Section 5.5, the performances of the companies were listed. The main goal of this section is to see if specific performances are related to the three configurations that emerged from the analysis of similar functionalities of levers. In figure 5.13, the business and people performances are reported.

Configurations→ **Performances**	**Focus on standard KM practices**	**Focus on hierarchical KM practices**	**Focus on diffused KM practices**
Business process performances	Time to Market Efficiency	Customisation and customer satisfact. Time to market Innovation of the solution	Customisation and customer satisfact. Innovation of the solution
People performances	Better use of time Sense of belonging	Better use of time Work satisfaction Sense of belonging	Work satisfaction Self esteem Sense of belonging Reduction of labour turnover

Figure 5.13: Business and people performances of the configurations

Companies characterised by focus on standard practices, show good performances in terms of time to market and price competitiveness, pushing the whole organisation towards the reuse of past solutions, with a high degree of collaboration among members of a dispersed team. They reduce travelling costs, and the time to connect people and to develop new solutions for recurrent problems (efficiency). At the same time, making explicit and storing solutions through ICT makes their codified knowledge base extremely strategic for themselves. As a consequence, they place a relatively low value on staff retention, and accept a high level of turnover especially in the early stages of the career path.

Companies focused on diffusing KM practices, demonstrate completely different business and people performance, especially in terms of the customisation of solutions and the satisfaction of customers (due to job rotation, each project leader has a better overall vision and knowledge). At the same time, employees demonstrate a higher level of satisfaction and self-esteem related to their work. For those companies, low labour turnover is extremely critical, as people keep most of the knowledge in a tacit form.

Companies focused on hierarchical KM practices exhibit business performances related not only to time to market but also to customisation and innovativeness. In terms of people performances, consultants emphasised the success of the company in terms of better use of time and, through accessing the knowledge provided by partners, they recognised their role in the organisation for as contributors to the development of the knowledge base (sense of belonging and work satisfaction).

The distinction among the three approaches can be also observed when considering the frequency of learning behaviours. Due to the different roles in the knowledge processes in the three configurations, the analysis of KPE can include a consideration of the frequency of learning behaviours of: consultants (C), managers (M) and centralised unit (U) for knowledge management (figure 5.14)[2].

Configuration → **Behaviours**	***Focus on standard KM practices***	***Focus on hierarchical KM practices***	***Focus on diffused KM practices***
B1: Individuals use the organisation's strategic goals and objectives to focus and prioritise their improvement and learning activities.	C/M:Not very frequent	C:Not very frequent	C:Not very frequent
B2: Individuals use activities as opportunities to develop knowledge.	C/M:Rather frequent U: Frequent	C:Rather frequent M:Frequent	C:Very frequent
B3: Individuals use part of available time/resources to learn.	C/M:Rather frequent	C:Rather frequent	C:Very frequent
B4: Individuals integrate knowledge among all different phases of the project where are involved.	C/M:Frequent	C:Frequent	C:Very frequent
B5: Individuals transfer knowledge among different projects.	C/M:Frequent	C:Frequent	C:Frequent
B6: Individuals abstract knowledge from experience and generalise it for application on new projects.	C/M:Not very frequent U: very frequent	C:Not very frequent M: very frequent	C:Rather frequent
B7: Individuals embed knowledge, making the knowledge available to others by incorporating it in vehicles.	C/M:Very frequent	C:Frequent	C:Rather frequent
B8: People try to assimilate and internalise knowledge from external sources.	C/M:Frequent	C:Frequent	C:Frequent
Very frequent= 5 Frequent=4 Rather frequent=3 Not very frequent=2 Not frequent at all=1	C: consultants M: managers U:dedicated unit		

Figure 5.14: Frequency of behaviours in the different approaches to knowledge management

Some differences emerge in the measurement of KPE that are primarily due to the type of role that consultants play in the knowledge process. For example, behaviours B2 and B3 assume that consultants (and managers) use their own activities to generate knowledge. In other words, a high frequency of B2 and B3 implies that people operate in both business processes and in knowledge processes with the same level

[2] The frequency of behaviours on a 1-5 point scale is reported in the table. The frequency has been measured through interviews to the managers of the consultancy companies.

of awareness. The low frequency of these behaviours for first two configurations (focus on standard KM practices and focus on hierarchical KM practices) means that consultants and managers, in the first configuration, and only consultants, in the second configuration, are not involved in both, but in only one, of the two processes. Similarly, considering B7, the configuration focused on standard KM practices strongly relies on the use of vehicles to make explicit and standardise knowledge and then transfer it throughout the organisation. The configuration focused on diffused practices, on the other hand, is mainly based on the accumulation of knowledge at an individual level and on communication among people, so that people do not embed knowledge into vehicles (i.e.B7 is less frequent. Similar conclusions can be drawn for B6, abstraction and generalisation of knowledge: at the consultants' level, knowledge is not abstracted and generalised at all, since they are not directly involved in knowledge processes. Moving the mapping of behaviours at a managerial level (for configuration focused on hierarchical practices) and at dedicated units (for configuration focused on standardised practices), results in less frequent behaviours becoming more frequent.

To sum up, a description of the KM configurations has been developed. In particular, three empirical configurations, based on similar functionalities of levers (RQ1.1 and RQ1.2) have been detected, and their performances have been observed (RQ1.3). In the following subsection, the relationship between configurations and the type of knowledge managed will be addressed (RQ1.4).

5.6.3 Types of knowledge managed in the configurations

The types of knowledge managed in the companies can be framed as follows:

1. *The level of explicitness of knowledge*. The epistemological classification of knowledge has been explained in the theory (Chapter 2- Polanyi, 1966; Nonaka, 1991; Quinn et. al. 1996). In the case study companies, the consultants accumulate knowledge from their own activities, while performing business processes. Such knowledge can be kept as either tacit or, at least in part, made explicit so that it can be capitalised upon in databases or communicated to others.
2. *The knowledge object*. The business process of consultancy companies can be modelled as a problem solving process (Werr and Stjernberg, 2001; Corso et al. 2002). This can be analysed in terms of a solution to the problem (i.e. the output of the process itself), the methodology followed to solve the problem (i.e. problem solving), and conditions in which to frame and solve the problem (i.e. problem setting) (Galbraith, 1973; Mintzberg, 1985). Therefore, knowledge can in the first instance concern the solution provided (know what) (Quinn et. al, 1996), in terms of the characteristics of the solution itself, and of the customer or the industry. Nevertheless, knowledge can also concern the methodology adopted (know how) in terms of the decomposition of the tasks into subtasks or management of the project (costs, risks, returns…) (Corso et al., 2002). Knowledge about the motivation concerns the problem setting: it includes the conditions which drive the choice of a specific methodology to produce an output. In other words, it is knowledge about causes and effects related to projects carried out (Spek and Spijkervet, 1996) (see also figure 5.15).

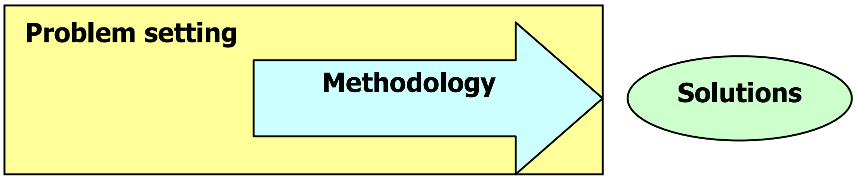


Figure 5.15: Typologies of knowledge object

3. The *level of abstraction and generalisation* of knowledge: the third dimension of classification represents the level of abstraction and generalisation of knowledge that can be contingent or generalised. Contingent knowledge represents knowledge about a specific case and is not related to other similar cases. A contingent solution is, for example, the history of a specific case, without any explanation or reflection about the similarities and differences with other cases (Bartezzaghi et. al. 1997). A contingent methodology, on the other hand, describes the process of analysis of the customer needs, of the proposal, development, and implementation of the solution. Moreover, a contingent problem setting refers to the clarification of the motivations driving a case (i.e. problem highlighted by the customer). Generalised knowledge derives from the process of abstraction and generalisation, and it comes from identification of classification schemes that are important components of the meta-models of the company (Bartezzaghi et. al. 1997). Each class defines the frame in which similar patterns of cause-effect relationship occur. A generalised solution, for instance, includes some general characteristics and guidelines about the customer, the industry, or the technology involved, resulting from the characteristics of similar cases and leading to the development of specific solutions for them. On the other hand, a generalised methodology is a common methodology for a group of similar cases. Generalised motivations are common conditions that drive the choices of consultants and of the customers in terms of methodology and solutions.

The case companies in adopting different KM configurations, focus their activities on different types of knowledge as illustrated in figure 5.16:

- First of all, most of the companies concentrate on *making solutions explicit*. This is a clear attempt to make knowledge concerning solutions efficiently retrievable. Further, making solutions explicit does not require a very great effort: reports used can generally be easily combined with the business activities, and are usually also required by the customer. All the companies, even the ones focusing on diffused KM practices, kept a database of reports that store solutions.
- Not all the companies *generalise solutions.* The process of generalisation of solutions implies the identification of similarities in the cases and the identification of classes (i.e. to build a meta-model). Generalisation of solutions was interpreted by the consultants as a way to facilitate the retrieval of cases, which otherwise would have been only a database of not-related histories. Two companies in the sample still stored contingent solutions, but this was only due to their specific situation: these companies are now working on their ICT infrastructure in order to provide the option of storing their cases. Nevertheless, it is very significant that the only two companies still storing contingent solutions focused on diffused KM practices: these companies have in the past relied on experience of

their consultants and only recently, due to their rapid growth and the number of available cases, they have begun to try and support their consultants with some ICT storing functionalities.

Configuration→ **Knowledge object**	***Focus on standard KM practices***	***Focus on hierarchical KM practices***	***Focus on diffused KM practices***
Issue/Motivation	Tacit Explicit	Tacit Explicit	Tacit Explicit
	Contingent Generalised	Contingent Generalised	Contingent Generalised
Methodology	Tacit Explicit	Tacit Explicit	Tacit Explicit
	Contingent Generalised	Contingent Generalised	Contingent Generalised
Solution	Tacit Explicit	Tacit Explicit	Tacit Explicit
	Contingent Generalised	Contingent Generalised	Contingent Generalised

Figure 5.16: Mapping of knowledge in the configurations

B
F
D
E
H
A
C
G

- In terms of knowledge about methodologies, it can be observed that the profile is different for the various configurations. It is interesting to see how companies that focused on standardised KM practices make a strong effort to make explicit and generalise methodologies. Their focus on efficiency and reuse of past solutions requires the systematisation, classification and availability of solutions and methodologies that they can adopt. In the case of companies focused on hierarchical KM practices, they are primarily concentrated on storing methodologies in a tacit form, and do not pay attention to developing common methodologies. The only particular case is company D: managers there invest a lot in developing and formalising methodologies for the analysis and design of business processes in order to implement technological solutions (ERP and e-business solutions). Companies focused on diffused KM practices keep most knowledge concerning methodologies tacit. An interesting situation was found at company A, which keeps methodologies tacit, but at the same time is able to generalise them. Through the communications and interactions among consultants, the company has succeeded in creating generalised methodologies. This result has been primarily reached through the identification of *experts.* The methodology adopted by a certain expert, in a specific field or discipline, becomes the generalised methodology.
- Companies that focus on diffused KM practices can manage knowledge concerning the motivation and issue, albeit in a tacit and contingent form. In other words, these companies facilitate the

identification, also at a tacit level, of issues and motivations that are related to projects. Managers explained how consultants in these companies develop knowledge about cause-effects relationships thanks to their understanding of the overall project, and to their deep participation in the problem solving process.

5.7 THE INTERPRETATION OF RESULTS

In previous sections, an analysis of the configurations of levers found in the case studies has been carried out. In particular, each configuration has been provisionally labelled and described, in terms of the functionalities and forms of levers, performances and types of knowledge managed. The main goal of this section is to explain and embed these results in theory[3].

Theoretical contributions on organisational structural dimensions (Mintzberg, 1985; Davenport et al. 1998) are often used to develop organisational typologies (Earl and Scott, 1999; Hansen et al., 1999), and therefore can be referred to in describing the characteristics of a KM configuration:

A. *Horizontal decentralisation.* Mintzberg (1985) addresses "horizontal decentralisation" to the extent to "which non managers control decision processes" (p.186) in a continuum from centralisation in one person, through centralisation in staff units (analysts), to diffusion in experts and finally in operators. Considering the relationship between knowledge (management) processes[4] and business processes (Hansen et al. 1999; Earl and Scott, 1999), such horizontal decentralisation can describe the extent to which the *responsibility* for knowledge management is centralised in specific roles (in particular staff roles) or specialised units, or, alternatively that it is combined with responsibility for operational activities. In particular, an organisation is highly horizontally decentralised if the responsibility for KM activities is spread throughout the organisation, instead of in specific roles, and therefore people are engaged in both operational and knowledge activities. According to Hansen et al. (1999), configurations with low horizontal decentralisation, on the other hand, specify ad hoc roles or specialised units to develop and manage knowledge (competence centres, full time experts), Such units are also in charge of managing and maintaining the knowledge base (Meyer and Zack, 1996).

B. *Vertical decentralisation* represents the extent to which knowledge (management) activities are delegated down through the levels of the company hierarchy. In other words, this dimension deals with the number of hierarchical layers that are formally involved in knowledge processes and with the intensity of their control. Mintzberg (1985) relates vertical decentralisation to the delegation process in the line, and mainly refers to the formal part of the decision-making process (making choices and giving authorisation) rather than the informal one (advice and execution of activities). Therefore, a configuration has a low vertical decentralisation if knowledge processes are mainly

3 The interpretation of results, as noted in chapter 4, has two main consequences from the methodological point of view: first of all it validates the framework and its operationalisation for the considered research setting, and then it allows the development of new insights from results concerning the existence and characteristics of knowledge management configurations.

4 As described previously in this chapter, knowledge processes involve the activities of acquisition, capitalisation and reuse, transfer and sharing of knowledge. Knowledge management activities, on the other hand, involve the activities of selection, implementation and management of levers to stimulate knowledge processes.

owned at managerial levels in the line. Conversely, it is highly vertically decentralised if knowledge management activities are delegated down through the hierarchy to the shop floor level.

C. *Coordination mechanisms*. Knowledge processes are supported by different coordination mechanisms (Mintzberg, 1985), which are fostered by the implemented configuration of levers. *Mutual adjustment* and *skill standardisation* are related to people and to relationships among them: that is to integration mechanisms and team, definition of roles and responsibilities towards knowledge management, job rotation, co-location, communication of values, and strict recruitment criteria (Hansen et al. 1999; Davenport et. al. 1996). *Output standardisation* is mainly related to performance measurement and reward systems (Mintzberg, 1985; Daft, 2001). *Work process standardisation* and *direct supervision* include the procedures, norms, and rules used to carry out the job within the organisation (Corso et al., 1998).

Literature shows how ICT functionalities support all these coordination mechanisms in different ways (Liebowitz, 1999): collaboration and communication functionalities, for example, can support mutual adjustment and skill standardisation (Zack, 1998) through supporting the relationships among people especially in dispersed environments. ICT storing functionalities especially support direct supervision, work processes, and output standardisation (Chapter 2). In this situation, ICT mainly supports the capitalisation and reuse of knowledge through principally storing and retrieving "knowledge units" (Meyer and Zack, 1998; Hansen et al. 1999). There is such a relationship between the functionalities of ICT in supporting coordination mechanisms, and the "vehicles" where knowledge is embedded and through which it is transferred throughout the organisation (Bartezzaghi et al. 1997) (see figure 5.17). In the former, knowledge is embedded in individuals in tacit or explicit forms (Nonaka, 1993) and it is shared by relying on mutual adjustment and skill standardisation. In the latter, knowledge is embedded in the knowledge base (Hansen et al. 1999; Venkatraman and Henderson, 1998; Stein, and Zwass, 1995): ICT supports the capitalisation and reuse.

Coordination mechanism	**ICT functionality**	**Embedment of knowledge**	**References**
Mutual adjustment	Communication and collaboration	Through individuals	Mintzberg, 1985 Liebowitz, 1999 Zack, 1998 Meyer and Zack, 1998 Hansen et al. 1999 Davenport et. al. 1998
Skill standardisation			
Output standardisation	Storage and retrieval of knowledge	Through accessing the corporate knowledge base.	
Work processes standardisation			
Direct supervision			

Figure 5.17: The use of vehicles and coordination mechanisms

The configurations of enablers derived from the case studies can therefore be explained in terms of the characteristics described in this section as represented in figure 5.18.

- *Centralised approach*. The configuration focused on standard KM practices corresponds to the centralised approach. It is characterised by low horizontal decentralisation, as most of the responsibility for knowledge processes is owned by a unit of analysts. Sometimes a CKO is appointed, and the organisation should ensure the development of adequate competencies. For example, Earl and Scott (1999) note that a chief knowledge officer should develop several competencies: a strategist in order to understand the knowledge useful for the business, a software and network technologist in order to understand the opportunities provided by ICT to manage knowledge, and finally a technician- a specialised role on the content of knowledge. The level of vertical decentralisation in this approach depends on the hierarchical level of those analysts in charge of managing knowledge activities. The main coordination mechanism adopted is standardisation (of work processes and output) that is principally enabled through the use of ICT to store solutions, which have been collected, analysed and generalised by the analysts (Mitzberg, 1985). People retrieve these solutions through distant and asynchronous ICT functionalities.

- *Oligarchic approach*. The configuration focused on hierarchical practices corresponds to the oligarchic approach. This configuration is characterised by low vertical decentralisation as knowledge activities are not delegated at all by managers. Horizontal decentralisation is medium, as responsibility is retained by managers having a dual role. It is interesting to note that the coordination mechanisms supporting this configuration reflect the organisational design choices: mutual adjustment within the community of managers, and direct supervision and work processes standardisation between managers and consultants concerning solutions and methodologies.
- *Decentralised approach*. The configuration focused on diffused KM practices corresponds to the decentralised approach. This configuration is characterised by high horizontal decentralisation with all the people involved in operative processes also having responsibility in knowledge processes. Vertical decentralisation is also high. Coordination mechanisms are based on mutual adjustment and skills standardisation, also enhanced by ICT, which is an enabling infrastructure for communication and collaboration.

Empirical labels→ ***Theoretical characteristics***	***Focus on standard KM practices***	***Focus on hierarchical KM practices***	***Focus on diffused KM practices***
Horizontal decentralisation	LOW SPECIALISED UNITS specialisation of people (no job rotation), development of knowledge professionals as specialists.	MEDIUM SUPPORT STAFF only a restricted group pf people are playing the dual role. Workers are involved only in business processes	HIGH WIDESPREAD RESPONSIBILITY people play a dual role in knowledge process and business process
Vertical decentralisation	MEDIUM definition of dedicated staff of middle managers	LOW HIERARCHICAL APPROACH managers playing the dual role in knowledge processes and in business processes. Workers involved only in business processes	HIGH COOPERATIVE every level a cooperative approach
Coordination mechanisms	STANDARDISATION OF WORK PROCESSES STANDARDISATION OF OUTPUT EMBEDDMENT OF KNOWLEDGE THROUGH TECHNICAL VEHICLES The Use of ICT to store knowledge, the communication is asynchronous and mostly distant	DIRECT SUPERVISION STANDARDISATION OF WORK PROCESSES EMBEDDMENT OF KNOWLEDGE THROUGH MIXED VEHICLES synchronous communication among managers through ICT, asynchronous communication among workers	MUTUAL ADJUSTMENT SKILL STANDARDISATION EMBEDDMENT OF KNOWLEDGE THROUGH RELATIONAL VEHICLES synchronous communication and collaboration through ICT and interaction among people
New denomination of configurations	**Centralised approach**	**Oligarchic approach**	**Decentralised approach**

Figure 5.18: The explanation of empirical results through theory

The results so far lead to a set of propositions, which will be refined in the subsequent chapters in order to fully answer research question 1 for consultancy companies (*What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge-intensive, innovative environments, and which performances are related to them?).*[5]

P1.1 If a specialist unit for knowledge management is allocated within the organisation, then coordination of knowledge management efforts is formalised through standardisation of KM practices (i.e. procedures). The application of these practices is supported by specific knowledge management roles in the organisation, and by ICT that stores and transfers solutions and methodologies in an explicit and generalised form. (Centralised approach)

[5] The name P1 indicated that the proposition is related to research question 1.

P1.2 If knowledge management is mainly a management task, a restricted group of people (managers) have joint roles as PM and knowledge owners. Managers constitute a "virtual community" where ICT support both synchronous and asynchronous communication and collaboration among them. ICT and managerial tools are used to capture knowledge from workers. The knowledge base is accessible to workers only through the manager (Oligarchic approach).
P1.3 If knowledge management is a diffuse responsibility; every worker has a dual role of performing process and knowledge management activities. Explicit managerial methodologies are implemented to foster and assess learning throughout the organisation. ICT mainly supports synchronous collaboration among teams (Decentralised approach).
P1.4 In the consultancy industry, the external factors which mostly influence the design of knowledge management processes are the degree of dispersion of activities, the level of complexity of the solution and of the project (and vertical integration), and labour churn
P1.5 If a company adopts a centralised approach, then it is successful in terms of time to market, efficiency (business performances), high sense of belonging and use of time (people performances)
P1.6 If a company adopts an oligarchic approach, then it will be successful in terms of customisation and customer satisfaction, innovation of the solution, time to market (business performances), use of time, sense of belonging and work satisfaction (people performances)
P1.7 If a company adopts a decentralised approach, then it will be successful in terms of customisation and customer satisfaction, innovation of the solution (business performances), work satisfaction, sense of belonging, self esteem and reduction of labour turnover (people performance).
P1.8 If a company adopts a centralised approach, then knowledge is strongly embedded in technological vehicles
P1.9 If a company adopts a decentralised approach, knowledge workers (consultants) are very much involved in seeing their activities as opportunities to develop knowledge and using their spare time to generate knowledge
P1.10 If a company adopts a centralised or oligarchic approach, knowledge is abstracted and generalised by a restricted group of people (managers or specialised unit)
P1.11 If an organisation adopts a centralised approach to manage knowledge, it is described in terms of low horizontal decentralisation (specialised units for KM), medium vertical specialisation, with coordination mechanisms based on standardisation of work processes and output, and the use of primarily technical vehicles for knowledge transfer and focus in managing explicit and generalised solutions and methodologies.
P1.12 If an organisation adopts an oligarchic approach, it is described in terms of medium horizontal decentralisation, low vertical decentralisation, with coordination mechanisms based on direct supervision and work processes standardisation, and the use of mixed technical and relational vehicles, and a focus on managing solutions and methodologies in both tacit and explicit forms.
P1.13 If an organisation adopts a decentralised approach, it is described in terms of high horizontal decentralisation, high vertical decentralisation (cooperative), with coordination mechanisms based on mutual adjustment and skill standardisation, and the use of primarily relational vehicles, and a focus on managing solutions, methodologies and issues in both tacit and explicit forms and both contingent and generalised forms.

5.8 SUMMARY

In this chapter, RQ1 has been addressed, analysing which configurations for knowledge management are adopted in successful consultancy companies. Results from empirical research in consultancy companies confirm the operationalisation of the framework of knowledge management in innovative environments.

The interpretation and explanation of the results through theory provides a description of typologies of KM configurations. Some issues remain unresolved in terms of fully answering the first research question:

- The generalisability of results in terms of industrial scope. In this chapter, a specific industry was investigated in terms of the relevance of knowledge processes in the companies and the coincidence of many business and knowledge activities. Evidence of generalisability of the results to other contexts would be desirable.
- The relationship with performances. In this chapter, the focus was on successful management consulting companies. This has only provided an opportunity to investigate whether some knowledge process behaviours are more frequent than the others in a general situation of success (from the business and people point of view). It would be interesting to investigate if external factors determine the success of a configuration (RQ2).
- The dynamic analysis of the configurations. In this chapter, only a description of the configurations has been provided, without considering the evolution of the configuration over time (What happens to the configuration, and to other levers, if one lever (specifically ICT) changes? What are the triggers and barriers of such changes?).

Chapter 6 considers the relationship between the configurations and the innovation strategies in consultancy companies; Chapter 7 analyses the applicability of the research propositions in a different research setting, and then Chapter 8 considers the dynamic aspects of the research.

END NOTES

1 An After-action review (AAR) is a discussion of a business event or action that enables the individuals involved to better learn from their daily business experiences. AARs ask the questions: What happened? How did it happen? Why did it happen? What was learnt? Fundamental to the success of an AAR is that the spirit should be one of openness and learning. AARs are not about problem fixing or allocating blame. What makes AARs so powerful are that they can be applied across a wide spectrum of events from two individuals conducting a five minute AAR at the end of a short meeting to a day-long AAR held by a project team at the end of a large project. Lessons-learnt are not only tacitly absorbed on the spot by the individuals involved but can be explicitly documented and shared with a wider audience. After-action reviews were originally developed and are extensively used by the US Army. (http://call.army.mil)

Learning history. Learning history is a document including a retrospective history of significant events in project, described in the voices of people who took part in them. Researched through reflective interviews and quote checked scrupulously, the learning history uses reflective story telling to help a company evaluate its progress in learning (and accelerate that progress). The flow of the document is meant to call to mind a tribal gathering: a group of people sitting around a campfire, each with a different perspective. Managers, hourly workers, union leaders, senior executives, suppliers, consultants, and customers are all included in the circle — identified only by position, as anonymously as possible. In this way, the document creates a record, which allows people to recognize their own blinders, and to see their own point of view in the context of a larger, shared understanding. (www.learninhistories.com)

Peer assist: is a meeting or workshop where people not directly involved, but owning specific knowledge, in a project are brought together to review and to recommend further areas to investigate in order to maximise the outcome for a specific piece of work. An example is represented by oil exploration specialists in British Petroleum requesting and receiving assistance via short visits from colleagues in similar company projects in other parts of the world (Dixon, N. www.acm.org/ubiquity/book/n_dixon_1.html)

Case based reasoning: In case-based reasoning (CBR) systems expertise is embodied in a library of past cases, rather than being encoded in classical rules. Each case typically contains a description of the problem, plus a solution and/or the outcome. The knowledge and reasoning process used by an expert to solve the problem is not recorded, but is implicit in the solution. To solve a current problem: the problem is matched against the cases in the case base, and similar cases are retrieved. The retrieved cases are used to suggest a solution, which is reused and tested for success. If necessary, the solution is then revised. Finally the current problem and the final solution are retained as part of a new case. Many people like case-based reasoning because they feel happier with examples rather than conclusions separated from their context. A case library can also be a powerful corporate resource, allowing everyone in an organisation to tap into the corporate case library when handling a new problem. (www.cbr-web.org)

Knowledge elicitation interview This methodology aims at acquiring and elicitation practical knowledge through several techniques: manual methods, semi automatic methods, and automatic methods. Manual methods Manual methods, according to Turban are "basically structured around some kind of interview. The knowledge engineer elicits knowledge from the expert or other sources and then codes it in the knowledge base. The three major manual methods are interviewing, tracking the reasoning process and observing. The tracking method, in particular is a protocol analysis. This method of knowledge elicitation is similar to the interview technique, but is more formal and systematic. This technique involves the knowledge engineer asking the expert to perform a task and verbalize his though process while the knowledge engineer records it on tape for later analysis. This recording is a record, or protocol, hence protocol analysis. During the session, the knowledge engineer watches and listens to the expert. Another technique is observation, where the knowledge engineer observes the expert at work. There are two types – motor and eye movement. In the case of motor, the knowledge engineer observes and records the expert" physical performance of the task e.g. walking, talking. In the case of eye movement, the knowledge engineer records where the expert fixes his gaze. This method is usually used as a supplement to verbal protocols. Probably the most common knowledge elicitation technique is interview analysis. There are two main types of interview – unstructured and structured. Both types involve the knowledge engineer conversing with the expert. Interviews are usually taped, and the knowledge engineer presents the expert with a simulated case or an actual problem. The "walkthrough" method can be used, whereby the expert is asked to solve the problem or find a solution and talk the knowledge engineer through it. Semiautomatic methods are divided into two categories – those that are intended to support the expert by allowing them to build knowledge bases with little or no help from the knowledge engineers by allowing them to execute the necessary tasks in a more efficient or effective manner. Finally, automatic methods are those where the roles of the expert and the knowledge engineer are minimized or even eliminated. (http://intsys.fin.qub.ac.uk)

CHAPTER SIX:
THE ROLE OF INNOVATION STRATEGIES FOR KNOWLEDGE MANAGEMENT

6.1 INTRODUCTION

The previous chapter discussed knowledge management configurations in eight consultancy companies. From the analysis of the functionalities of the levers implemented by these companies in order to foster knowledge processes, three main knowledge management configurations have emerged which have been described in terms of characteristics and forms of levers, performances and contingencies.

The main goal of this chapter is to focus on the contingent situation of consultancy companies and to identify peculiarities of the knowledge management configurations related to one specific external variable: innovation strategies.

As discussed in Chapter 2, various academics have debated how knowledge management practices are influenced by innovation. Knowledge processes and learning in innovative contexts cannot be based on repetition: key issues are seen as unlearning (Hedberg, 1981, Bartezzaghi et al. 1997), double loop learning (Argyris and Schon, 1978; McKee, 1992), and inter-project learning (Bartezzaghi et al. 1997); and specific levers have to be designed to support these processes. For example, Bartezzaghi et al (1997), highlight how, to foster knowledge processes in innovative contexts (as projects), levers have to be designed according to three managerial principles: they have to support the management of feedbacks, support the use of vehicles to embed knowledge, and finally they have to support the adoption of classification schemes to enhance abstraction and generalisation.

Managers in the consultancy companies have indicated that the level of vertical integration in the company influences the choice of functionalities of the levers to implement. It has been discussed how the vertical integration of the company is related to different strategic priorities (business performances) and different critical issues from the knowledge management point of view (Section 5.5.3).

Specifically, this chapter addresses research question 2:

RQ2: Is a particular KM configuration aligned with a specific innovation strategy?

RQ2.1 Is a KM configuration associated with a specific innovation strategy?

RQ2.2 Does an innovation strategy influence the success of a knowledge management configuration?

The aim is to investigate the association between innovation strategies and knowledge management configurations, focusing on successful consultancy companies. To achieve this, two main tasks are carried out:

- Operationalise the innovation strategies adopted by consultancy companies
- Analyse whether a KM configuration is associated with an innovation strategy

In Section 6.2, a brief framework to classify innovation strategies is provided, which is operationalised for consultancy companies in Section 6.3. Then, in Section 6.4, the association between the innovation strategies, and the configuration of levers adopted, for knowledge management will be investigated.

6.2 THE DIMENSIONS OF INNOVATION STRATEGIES

A central concern of studies about innovation strategies is the relationship between the exploration of new possibilities and the exploitation of old certainties (March, 1991). Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, and execution. Maintaining a balance between exploration and exploitation is a primary concern in system survival and prosperity. As a consequence, organisations make explicit and implicit choices between the two. Understanding the choices, and improving the balance between exploration and exploitation, is complicated by the fact that returns from the two options vary not only with respect to their expected values, but also with respect to their variability, their timing, and the involvement of other actors outside the organisation. From a strategic point of view, an organisation is an exploiter when it refines and extends existing capabilities in order to become or remain competitive in its strategic position. On the other hand, it is an explorer when it engages in experimentation with new alternatives (Hitt et al., 1997; Zack, 1999b). Using these definitions, some observations can be drawn about the relationship between exploitation and exploration, and their relationship to knowledge management.

First of all, exploitation and exploration strategies are related to the degree of innovation, classified as either incremental or radical innovation (Zack, 1998). Incremental innovation tends to reinforce the competitive positions of established firms since it builds on their core competencies ("competence enhancing").

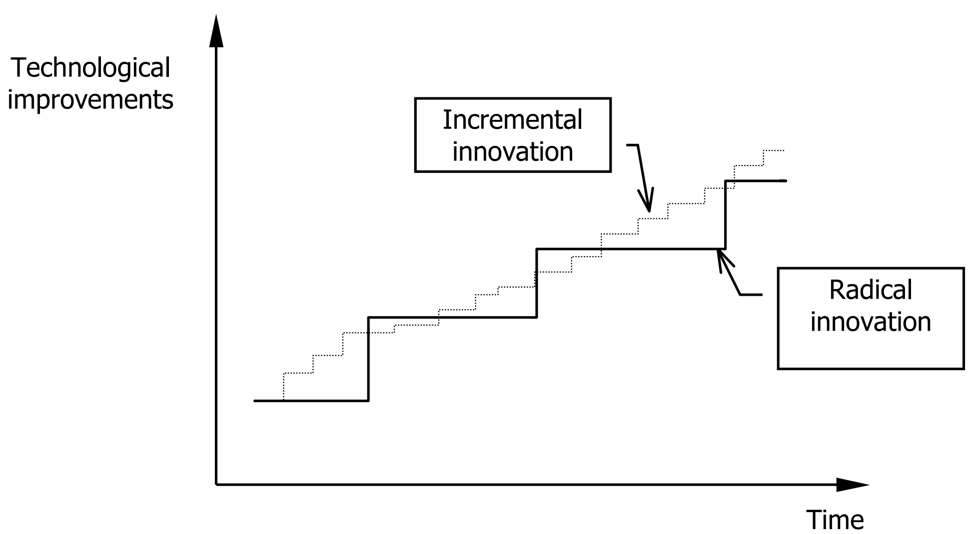


Figure 6.1: Radical and incremental innovation

In other words, it builds on the existing architectural and component knowledge of an organisation (Henderson and Clark, 1990). *Radical innovation,* in contrast, creates unmistakable challenges for established firms, since it limits the usefulness of their capabilities, i.e. of both architectural and component knowledge (Wheelwright and Clark, 1992; Henderson and Clark, 1990; Foster, 1986). As reflected in figure

6.1, incremental innovation is focused on a series of different projects (in NPD, they constitute a product trajectory). With radical innovation, each project is distinct. This distinction leads to clear differences in terms of expected profitability as, in the first case, the objective is set on the overall product family and not on the single project, while in radical projects, each project should be self sustaining (Sakakibara, 1994). From the knowledge management point of view, the two typologies of innovation infer a different type of knowledge base for the projects carried out. Incremental innovation exploits accumulated knowledge along the trajectory (Dodgson, 1993, Walsh and Ungson, 1991, Collis and Montgomery, 1995), and "the decision network utilises information inputs to develop projects without changing existing organisational norms and technologies" (McKee, 1992, p.236). Radical innovation produces fundamental changes in the activities of an organisation and produces clear departures from existing practices (Gopalakrishnan and Bierly, 2001). In the cybernetic model of learning suggested by McKee (1992), and described in Chapter 2, the organisation utilises information inputs to develop projects that change existing organisational norms and technologies. This means that the knowledge processes, when a company pursues a radical innovation strategy, are more difficult, as projects are distinct in terms of causes and effects, each of them presenting context-specific variables which are hardly transferable, and creating a separation in terms of time and space from previous projects and future applications (Bartezzaghi et al. 1997). In such a situation, to successfully perform knowledge processes, theory points out to the practices of *abstraction and generalisation* (Bartezzaghi et al. 1997), *double loop learning* (Argyris, 1978; McKee, 1992), *experimentation* (Huber, 1991) and *unlearning* (Hedberg, 1981) as extremely relevant (Chapter 2).

Looking at exploration and exploitation strategies it can be observed that they are not mutually exclusive (March, 1991; Hitt et al. 2000): exploration can provide knowledge to propel the company into new niches, and exploitation can provide the financial capital to fuel successive rounds of innovation and exploration (March, 1991; Zack 1999a). However, March (1991) points out that companies "consistently fail" to integrate exploitation and exploration strategies successfully. One reason of this is that the two strategies often involve different parts of the organisation, which are separated temporally, culturally and organisationally (Zack, 1999b). Therefore, one condition, in determining the success of the combination, is the link and coordination between the people involved in exploration and exploitation within the organisation. This can be achieved not only through internal knowledge transfer capability among R&D, sales, marketing, manufacturing, and the customer (Clark and Fujimoto, 1991), but also through specific management enablers (i.e. incentives) which support such flows of knowledge (Bartezzaghi et al. 1998).

Due to their relationship with knowledge processes, *exploitation and exploration* can be considered as the *first dimension* in classifying innovation strategies, namely: "the overall approach an organisation intends to take to align its knowledge resources and capabilities to the intellectual requirements of its strategy" (Zack, 1999c, p.134).

The *second dimension* concerns the *primary sources of innovation*. Innovation can be internal if it is mainly driven by actors and forces within the organisation. Innovation can also come from external sources, exploiting knowledge coming from publications, universities, government agencies, consultants, suppliers, and customers (Imai et al. 1985; Clark and Fujimoto, 1991; Afuah and Bahram, 1995). Internal sources provide knowledge which can be unique, specific, and difficult to appropriate if tacitly held (Zack, 1998; Lubit, 2001). Knowledge from outside is more costly to obtain, more widely available to competitors, but at the same time, it can result in new and unique insights (Zack, 1999c) if combined with internal knowledge.[6]

A combination of the two dimensions is represented in figure 6.2. Firms oriented towards exploitation, and relying principally on internal sources of innovation, exhibit the most conservative strategy, while unbounded innovators represent the most aggressive strategy. Companies can also adopt intermediate strategies: they can explore new solutions relying on internal sources (principally R&D) or pursue an exploitation strategy also involving external actors (i.e. belonging to a consolidated network). This representation leads to some considerations: first of all, the need to identify the metrics that can position a company within this scheme. As an example, Bierly and Chakrabarti (1996) developed a specific metric for the pharmaceutical industry. They suggest R&D intensity (ratio of annual amount spent on R&D to the firm's total sales) to measure the level of internal innovation, and patent citation to evaluate the flow of knowledge to the firm from external sources for innovation. Whether a pharmaceutical firm preferred radical as against incremental innovation has been measured using the ratio of New Chemical Entities to approved New Drug applications.

Another emerging issue is the discussion on which external factors drive a certain strategy (e.g. changes in the environment, focus on innovativeness of solution provided, competitors…). Many contributions in the strategy literature (Grant, 1991; Leonard-Barton et al. 1994) address this issue, but this will not be developed further in this thesis: the innovation strategy is represented here as an independent variable, without analysing which external factors drive its selection.

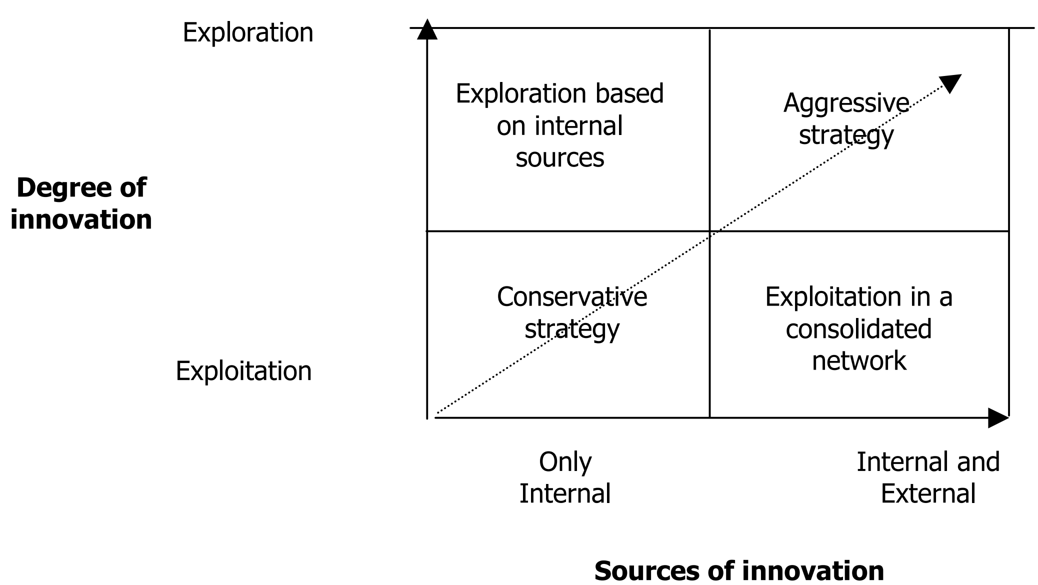


Figure 6.2: The innovation strategies (adapted from Zack, 1999c, p.136)

In this thesis, to address RQ2 (is a particular KM configuration aligned with a specific innovation strategy?), the following activities are completed in line with the reasoning described in Chapter 4:

[6] In this thesis, the perspective of relying only on external sources of innovation is not considered. This perspective is related to learning as adaptation in line with stimulus-response theory (Daft and Weick, 1984) which has been described in Chapter 2. It is therefore assumed that if innovation is externally sourced, knowledge has to be interpreted and combined with internal knowledge.

- Provision of a framework to operationalise the innovation strategies of consultancy companies (Section 6.3). While, in other studies (Bierly and Chakrabarti, 1996), operationalisations have been provided for certain industries, a model to assess the innovation strategies of consultancy companies is lacking.
- Analysis of whether a knowledge management configuration is associated with specific innovation strategies (Section 6.4).
- Analysis of which lever functionalities in the configuration support these innovation strategies (Section 6.4).
- Consideration of the impact of missing association on performances (Chapter 7).

6.3 THE INNOVATION STRATEGIES OF THE CONSULTANCY COMPANIES

The purpose of this section is to provide an operationalisation of the innovation strategies followed by consultancy companies.

Exploration versus exploitation strategy for consultancy companies

As discussed already, exploration and exploitation are related to the degree of innovation embedded in projects carried out by the organisation (Gopalakrishnan et Biertly, 2001).

According to Clark and Salaman (1996, p.176), the value added in management consulting concerns impression management, i.e. "the impact of consultants is dependent upon beliefs about them to be able to offer something of value to clients. The beliefs are formulated not by an objectivistic and functionalist knowledge-base but by the manipulation of myths and symbols through language". From this perspective, the level of innovativeness of the solution is not embedded in the requirements of the customer since it depends on the newness of the problem, and of the output developed (in terms of solution, methodology or scenario as described in Section 5.3) (Werr and Stjernberg, 2001; Hansen et al. 1999). Maister (1982), in particular, categorises professional service projects into three types: brains, grey hair and procedure. "Brains" are extremely innovative projects, which are usually related to new solutions to new problems. "Gray hair" projects may require highly customised output, but less innovation and creativity. Finally, "procedure projects" usually involve well-recognised problems where customisation can be accomplished through elements of routines and procedures. The classification dimension can be related to "design specificity" (Winch and Schneider, 1993). Similarly, Hansen et al. (1999) state that consultancy companies can focus on "providing high-quality, reliable and fast information-system implementation" (p.109). In this situation, they are primarily concentrated on the implementation of a solution (usually IT systems). Therefore, their strategy stresses achieving large overall revenues, and a one-off investment in a knowledge asset (i.e. knowledge on a specific IT system) and then reusing it many times over (*exploitation strategy*). The level of customisation of the solution is limited by the reuse of the solution selected. Alternatively, other companies may aim at "providing creative, analytically rigorous advice on high-level strategic problems"(p.109). Firms offering this service are focused on maintaining high profit margins by charging high fees for highly-customised solutions to unique problems (Hansen et al. 1999) (*exploration strategy*). Such companies are usually not directly in charge of the implementation.

Internal versus external sources of innovation

In terms of consultancy companies, the internal and external sources of innovation are considered in relation to the boundaries of the organisation:

- *Universities* are typical sources of innovation. Consultants participate in conferences and meetings in order to relate to different forms of knowledge (Hansen et al. 1999).
- *Suppliers* can be a source of knowledge, especially when the consulting project requires different skills (i.e. organisation and technology), and when a network of different consultants is involved in the project, or working together for a certain customer (for example in the problem setting and implementation phase) (Werr and Stjernberg, 2001).
- *Customer and the role of consultants*. The customer is a very important source of innovation for the consultant, and the interaction between them, which has been modelled in literature on management consulting, has been identified as having two different approaches. The *expert model* (Schein, 1987) requires that the client has made up his mind on what the problem is, what kind of help is needed, and to whom to go for this help. This implies that the consultant has to solve a problem that has been clearly identified by the customer, but who cannot solve it. The model requires the customer to have diagnosed the issue correctly, since the consultant is not always involved in the problem-setting phase. However, once the consultant starts to manage the project, they have full responsibility for suggesting a solution that best solves the problem. In this situation, the main source of innovation is internal, as the consultant has to provide a solution in line with the problem set by the customer, who does not contribute to the development of the solution. The *process model* (Schein, 1987) is defined as a set of activities on the part of the consultants that helps the client to perceive, understand, and act upon the process events that occur in the client's environment in order to approve the situation as defined by the client. In this model, the customer owns the process throughout the whole consultation work, and the consultant has only a supportive function. It is important that the main competence of the consultant is to facilitate the problem setting and problem solving process of the customer. In this event, most of the knowledge about the solution is external, as the customer has a more active role in the project, although this can be successfully developed through the knowledge of the consultant (which is principally related to the methodology).

  In this thesis, the two models are seen as complementary, and consultants can combine them in different phases in a very eclectic way (see also Stjernberg and Werr, 2001). For example, as discussed in the next section, some consultants use the process model in the problem setting phase, working with the customer in order to identify the issue and then, according to their strategy, adopting either an expert approach or a process one. Therefore the application of the two models, in this research, will be principally used to operationalise the level of interaction with the customer, and hence the relevance of external source of innovation (Maister, 1982).

In figure 6.3, the operationalisation of innovation strategies for consultancy companies is illustrated. It is particularly important to stress that the innovation process, and the relative innovation strategy, refer to the consultant and not necessarily to the customer. In other words, a project can be extremely innovative for the customer but at the same time not very innovative for the consultancy company which may have developed several similar projects in the past. Conversely, a project could be extremely innovative for the consultant, due to the newness of the topic addressed, but not so for the customer company which could have previously been involved in similar projects.

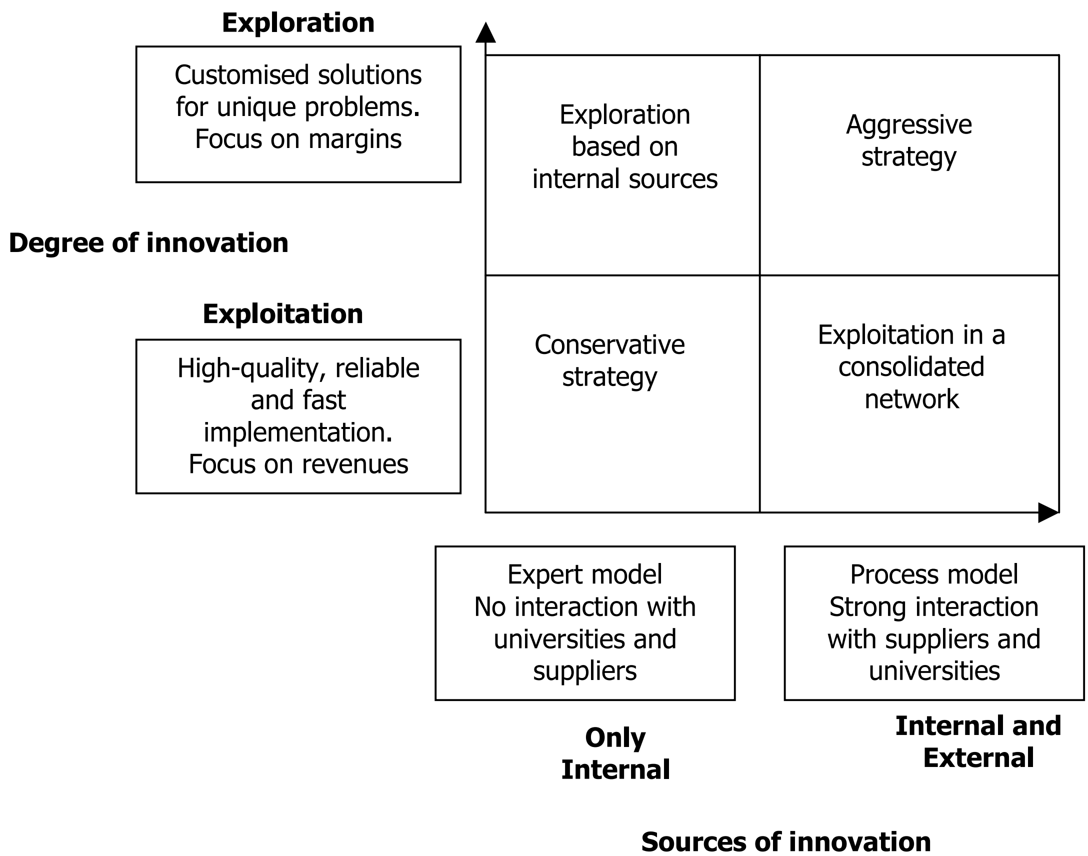


Figure 6.3: The innovation strategies for consultancy companies

According to the model represented in figure 6.3, the assumptions are that:

- *The innovation strategy of a company can be classified according to the level of innovation. Companies primarily adopt an exploration strategy when they develop projects, which include radical innovations (technological, market, organisational). Companies pursue an exploitation strategy if they develop incremental innovations, which tend to reinforce their competitive positions.*
- *The innovation strategy of a company can be classified according to the source of innovation. A company can rely only on internal sources of innovation, or leveraging on external sources (suppliers, customers, competitors…)*
- *Consultancy companies dealing with new problems, developing new solutions (to them) or highly customised solutions to unique problems, and that are focused on high profit margins, pursue an exploration strategy.*

- *Consultancy companies that reuse past solutions, develop high quality, reliable and fast implementation, and that are focused on revenues, pursue an exploitation strategy.*
- *The role of the consultant in the interaction with the customer, a dimension in the operationalisation of the involvement of external sources, can strongly determine the characteristics of the solution developed.*
  - *A consultancy company relies on internal sources of innovation if the consultants are the main actors in all phases of the consultancy process, and the customer is not involved in the development of the output. Companies implementing expert models of consultancy, principally rely on internal sources of innovation without leveraging on the customer as a source of innovation.*
  - *A consultancy company relies on external sources of innovation if consultants interact with other actors in order to develop the consultancy process and to achieve an innovative output. Companies implementing process models of consultancy involve external sources of innovation.*
- *External sources of innovation for consultancy companies are universities and suppliers*

The preliminary proposition, to be refined through the RQ2[7], is:

P.P.3 The innovation strategies adopted by companies influence the knowledge management configuration implemented and its effects on performances.

The main goal of the following sections is to analyse empirical results in order to see if the innovation strategies adopted by the companies in the sample are associated with knowledge management configurations discussed in Chapter 5, and to explain this association. Using this methodology, the proposition can be refined.

6.4 A CONTINGENT APPROACH FOR KNOWLEDGE MANAGEMENT CONFIGURATIONS

In the previous section, the dimensions for mapping the innovation strategy of consultancy companies have been described. The main goal of this section is to highlight the innovation strategy of the companies involved in the sample, in order to investigate whether a relationship exists between the innovation strategy implemented and a knowledge management configuration.

Managers of consultancy companies have been interviewed with the aid of a questionnaire (appendix 3). The innovation strategy has been assessed through the first part of the questionnaire, addressing the business areas (in terms of relevance, dispersion, evolution over time), strategic priorities (in terms of industry and strategic positioning of the company compared with main competitor), the type of consultancy service provided (strategic vs. operative), the level of complexity of the output provided (solution or methodology), of the portfolio and of the system, and finally the role of the consultants and others (i.e. the customer) involved in the management consulting projects. The main characteristics related to the innovation strategies of consultancy companies are summarised in figure 6.4.

[7] The first two preliminary propositions were referred to RQ1.

COMPANY	Exploration vs. Exploitation	Only internal vs. Internal and External
	Centralised approach	
Company B	-The strategic priority is turnover. -Low innovativeness (for them) of solution provided. Operative consulting and reuse of solutions.	-The focus is on the team of consultants operating in the company. The customer does not own the problem. Mainly expert model. -Strong interaction with universities and suppliers in order to improve current solutions.
Company F	-The strategic priority is turnover. -Low innovativeness (for them) of solution provided. Operative consulting and reuse of solutions.	- The consultation is based on internal contributions. The customer is not really involved. Mainly an expert model. -Strong interaction with universities and suppliers in order to improve current solutions
	Oligarchic approach	
Company D	-The strategic priority is *innovativeness* of the *solution* related with existing methodology. -Through another company in the group they provide either strategic consulting or *complete service*.	-They mainly implement an expert model as they rely on the methodology of the group. -They rely on much external collaboration with very young people. The core competence about the methodology is internal. -Strong interaction with universities and suppliers in order to generate new solutions and improve current ones.
Company E	-The strategic priority is *innovativeness* of the solution provided (usually a methodology or scenario). -The core competence is to always build new solutions for new customers in a very short time.	-Focus on strong competencies of the consultants whose main competence is to develop "possibility analysis". Expert model. -Strong interaction with universities and suppliers to generate new solutions, methodologies and scenarios.
Company H	-The strategic priority is *innovativeness* of the solution, based on existing methodology. -They provide *complete service*.	-They mainly implement an expert model as they rely on the methodology of the group. -Strong interaction with universities and suppliers to generate new solutions and improve current ones.
	Decentralised approach	
Company A	-The strategic priority is *innovativeness* of solution, methodologies and scenarios provided. -Focus on *high margins*	-Focus on strong competencies of the consultants whose main competence is to develop "possibility analysis". Expert model. -Strong interaction with universities and suppliers to generate new solutions, methodologies and scenarios.
Company G	-The strategic priority is *building customer loyalty*. -They define themselves as "knowledge craftsmen" as they always develop new solutions and methodologies with their customers. -Plans for internationalisation	-Implementation of *process model* in all the phases of the consultancy process. Their main reference is the customer and they act as support for the customer. -Strong interaction with universities and suppliers to generate new methodologies
Company C	The strategic priority is *building customer loyalty*. -They *develop new solutions and methodologies* with the customer.	-Implementation of *process model,* especially in the problem setting phase of the consultancy process. -They do not own the problem but they support the customer in their decision. -Strong interaction with universities and suppliers to generate new methodologies

Figure 6.4: The innovation strategies of consultancy companies

From the information outlined in figure 6.4, some observations can be made. First of all, companies adopting a *centralised approach* focus their strategy on the use of standard solutions and methodologies, and their priority is related to turnover. Their customers usually employ more than one consultancy company to manage the different phases of a project. For instance, they involve a consultancy company with a more strategic approach (such as A) for the problem setting; and involve companies such as B or F to manage the implementation phase. Then, companies such as B and F, whose intervention is often related to the implementation of new IT systems (i.e. ERP), own the problem and interact with the customer, especially in the change management phase of the intervention when the solution has to be integrated in the organisation.

The opposite situation applies to companies adopting the *decentralised approach* towards knowledge management. Their focus is on providing highly customised solutions, which are characterised by higher levels of innovation than solutions provided by companies adopting a centralised approach. These companies are focused on the interaction and collaboration with the customer, who is usually involved in the process of developing the new solution, methodology, or scenario. In order to achieve this goal, they need the ability to understand the customer's problem, to design an ad hoc solution and a change management path for its implementation, without leading this phase. The key performance indicator for these companies is not turnover but margin. In terms of the relationship with external sources of innovation, these companies establish a more interactive relationship with the customer. The role of companies C and G is particularly oriented towards supporting the customer in the problem-setting and problem-solving phases.

For companies implementing an *oligarchic approach*, the innovation strategy is somewhere in the middle. These companies can provide strategic consultancy, but can also support the implementation phase depending on the requirements of the customers. They position themselves closer to the centralised approach if their focus is more on the reuse of solutions than on the creation of new ones. Conversely, they are positioned closer to the decentralised approach if they focus more on strategic consulting and on developing new solutions.

A final observation concerns the role of universities and suppliers as external sources. All the companies pointed out the relevance of interaction with universities in order to obtain best practices and then to improve the quality of solutions and the efficiency of their processes. Similarly, most of the consultants in the sample noted that, when carrying out projects in customer companies where other consultants are working, they took the opportunity to exchange experiences.

In figure 6.5, the positioning of the companies is depicted. It is important to note that this is a qualitative positioning, and that there are no effective absolute measures on the two axes and boundaries between internal and external sources, and between exploitation and exploration strategies. An interesting observation is that none of the companies in the sample are positioned in the intermediate quadrants (exploration-internal and exploitation-external). This can explained by the specific activity of consultants since pursuing an exploration strategy, mainly based on internal sources, requires investment in an R&D unit. The richest knowledge of consultancy companies comes from the interaction with customers and, in many cases, from abstraction and generalisation of knowledge developed in single projects. Conversely, exploitation strategies primarily based on external sources assume that there is an opportunity to reuse and improve solutions and methodologies coming principally from the customer. This requires dealing with customers with similar problems, or with ones that can be approached through a similar methodology. None of the considered companies specialised on a particular target group of customers: they approach customers in different industries and with different problems.

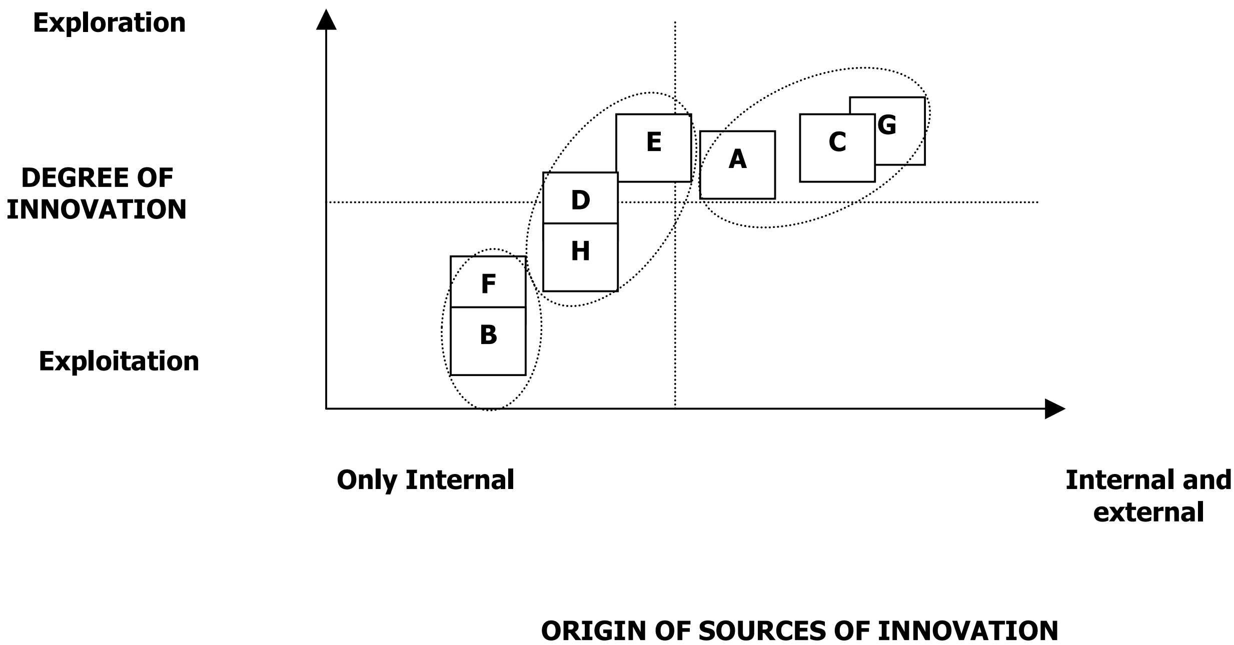


Figure 6.5: The positioning of consultancy companies

Further observations can be made with regard to the *type of knowledge* that the company provides to its customers.

Figure 6.6 represents the relationship between knowledge released to the customer, the type of knowledge managed by consultants, and the innovation strategy pursued by the company.

If the focus moves from reuse and implementation of existing solutions (as the centralised approach) to the development of new solutions (as in the oligarchic), the innovation strategy moves from exploitation to exploration. Moreover, if the focus moves from releasing solutions (existing and new ones), based on *generalised* knowledge (as in the centralised and oligarchic approaches), to the development of new methodologies and in some cases scenarios based on *contingent* knowledge (as in the decentralised approach), the source of innovation changes: from predominantly internal (with strong contributions from universities and suppliers) to principally external based on a strong interaction with the customer. In other words:

- According to the results reported in Chapter 5, companies C and G rely on *contingent knowledge* concerning *solutions*. Their knowledge management configuration is based on people storing knowledge, but without levers being implemented to foster abstraction and generalisation. Consultants have developed, albeit stored in a tacit form, knowledge concerning methodologies and issues/motivations (i.e. causes of particular problems in the specific industry), which is directly applied in the interaction with customers. The *process model* of consulting emphasises the use of this type of knowledge: the customer is involved in setting the problem and together with the consultant developing the solution. As knowledge concerning solutions is not abstracted and generalised, past solutions cannot be systematic reused. The customer is very much involved in developing the output of the consultancy service and brings the specificity of the requirements and the context. The consultant facilitates the generation of the new solution or methodology through the knowledge they own about the methodology and issue/motivation.

COMPANY	**Output provided to the customer**	**Type of knowledge managed by consultancy companies**
Centralised approach		
Company B	*Existing solution*	*Generalised*, explicit knowledge about solutions and methodologies[8]
Company F	*Existing solution*	*Generalised*, explicit knowledge about solutions and methodologies
Oligarchic approach		
Company D	*New solution*	*Generalised* explicit knowledge about solutions and methodologies
Company E	*New scenario, set of possible solutions, methodologies*.	*Generalised* explicit knowledge about solutions and tacit and contingent knowledge about methodologies.
Company H	*New solution*	*Generalised* explicit knowledge about solutions and tacit and contingent knowledge about methodologies
Decentralised approach		
Company A	*New scenarios, set of possible solutions, methodologies*.	*Generalised* explicit knowledge about solutions; tacit and generalised knowledge about methodologies; tacit and contingent about motivations
Company G	*New methodologies* and *solutions*	*Contingent* explicit knowledge about solutions; tacit and contingent knowledge about methodologies; tacit and contingent about motivations
Company C	*New methodologies* and *solutions*	*Contingent* explicit knowledge about solutions; tacit and contingent knowledge about methodologies; tacit and contingent about motivations

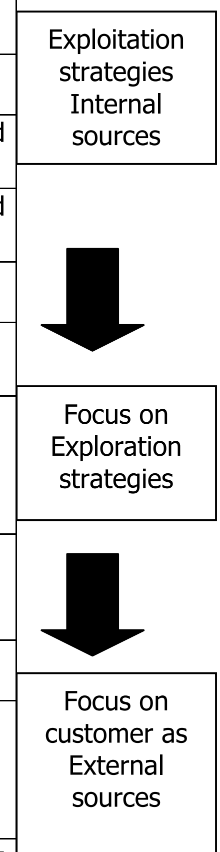


Figure 6.6: Knowledge released to customers, and types of knowledge managed by consultants

Two consequences derive from this: firstly, the high level of innovation related to each project because of the dependence on the customer's role and requirements. Then, the characteristics of the configurations: consultants have to perform their facilitation role in a very flexible way and so they exhibit a strong delegation (high vertical decentralisation) in managing the relationship with the customer. Therefore, such companies, as described in Chapter 5, recruit highly skilled people with a systemic (rather than specialised) background, offer incentives, practice job rotation, and train people

[8] As pointed out in chapter 5, these methodologies concern the problem solving process required in each project managed by consultancy companies.

through mentoring (experienced and new people belonging to the same team operating at the customer site).

- Adopting a decentralised approach, Company A has developed a more structured knowledge management system for the abstraction and generalisation of knowledge about solutions, mainly through emphasising the role of experts. It is such a level of *generalisation* that allows company A to adopt an *expert* approach with the customer, and provide solutions, methodologies and scenarios from its accumulated knowledge base. This is not possible for companies C and G who have not yet developed such generalised knowledge, and therefore have to support the customer in the development of a solution/methodology instead of owing the process. It is interesting to note how the level of vertical decentralisation in company A is relatively low compared with that in companies C and G. This is due to the fact that the experts, in company A, are positioned at a higher level in the hierarchy due to their expertise.
- Company E is a particularly interesting case; it develops scenarios and methodologies by adopting an oligarchic approach and mainly relies on internal sources of innovation (*expert model* with external relationships with universities). The innovation strategy pursued by company E is very similar to company A's, but the configuration is to an extent different: the main difference being the level of vertical decentralisation. Company E does not rely on experts, but on knowledge about solutions which has been accumulated by partners, then codified and stored in the ICT system and transferred through documents. From the abstraction and generalisation viewpoint, the role of the partners, in this situation, is very similar to the one played by experts in company A, but with a lower level of vertical decentralisation.

From the research findings, it is possible to derive conclusions about the relationship between the innovation strategy and the type of knowledge managed by consultancy companies, and therefore with the implemented configuration. According to the framework of types of knowledge, as described in Chapter 5, two main dimensions seem to characterise the adoption of innovation strategies: the generalisation (and generalisability) of knowledge, and the knowledge object (solution-methodology-motivation).

Figure 6.7 represents the different situations. In each situation, the innovation strategy adopted, and the roles of consultants and customers, can be highlighted.

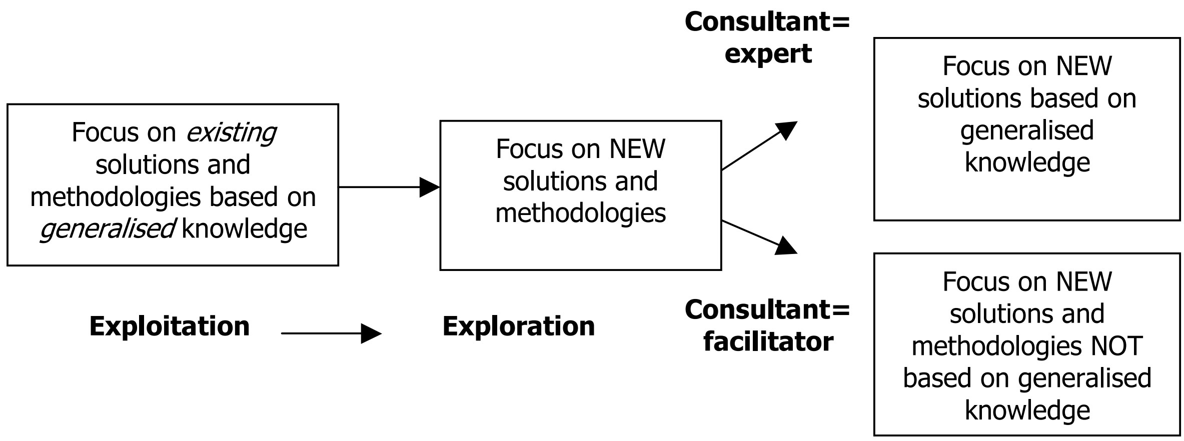


Figure 6.7: The types of knowledge and innovation strategies

1) *Focus on existing solutions based on generalised knowledge*. If consultancy companies own knowledge about solutions and methodologies, which is generalisable and is actually generalised, they can be extremely efficient in reusing and releasing existing solutions (centralised approach). Companies can adopt an exploitation strategy and, owning a large knowledge base, they can rely on *internal sources*. However, the relationship with universities and suppliers is important to improve and update the knowledge base.
2) *Focus on new solutions and methodologies*:

A. *Focus on new solutions based on generalised knowledge*. If consultancy companies own generalised knowledge about solutions, methodologies and motivations[9], they adopt an exploration strategy aiming to develop new solutions and methodologies. In this situation, the consultant is the expert, and the customer contributes in the development of the new solution by providing the specificity of the context to customise or innovate the solution. Here, the *customer is considered a relevant source of innovation* (together with universities and suppliers) to improve and update the knowledge base. The consultant plays the expert role.

B. *Focus on new solutions and methodologies, based on not generalised (contingent) knowledge*. If the knowledge management system does not foster the generalisation of knowledge (knowledge is contingent), consultancy companies can adopt an exploration strategy that aims to develop new solutions, but at the same time the *customer owns the process* and the consultant's role is mainly supportive (process model) and strongly based on knowledge about methodology and motivations.

A set of propositions can be developed from the results obtained answering RQ2 (*Is a particular KM configuration aligned with a specific innovation strategy?)*:

[9] Knowledge about methodologies and motivations is either generalised or contingent.

P2.1 If a consultancy company pursues an exploitation strategy, and implements knowledge management configurations that support the capitalisation and reuse of existing generalised solutions and methodologies, then it is successful in terms of efficiency and revenues.
P2.1.1 If a company adopts an innovation strategy based on the *exploitation* of solutions/methodologies and *internal sources of innovation*, and the *centralised approach* supports acquisition, capitalisation/reuse, transfer/sharing of knowledge; it is successful in terms of efficiency and revenues.
P2.2 If a consultancy company pursues an exploration strategy and implements knowledge management configurations supporting the acquisition, capitalisation and reuse, transfer and sharing of new solutions and methodologies; it is successful in terms of innovativeness, customisation of solutions, and margins.
P2.3 If a consultancy company adopts a strategy based on internal sources of innovation (playing an expert role with the customer) and implements knowledge management configurations supporting the generalisation of knowledge about solutions; it is successful in terms of innovativeness, customisation of solutions and methodologies and margins.
P2.3.1 If a company adopts a *exploration* strategy (in terms of solutions/methodologies) and *internal sources of innovation,* and the *oligarchic approach* supports acquisition, capitalisation/reuse, transfer/sharing of knowledge; it is successful in terms of customisation, customer satisfaction, innovativeness of the solution, people performances (use of time, sense of belonging and work satisfaction) and knowledge performances (abstraction and generalisation-B6-transfer of knowledge –B4 and B5).
P2.3.2 If a company adopts an innovation strategy based on *exploration* of solutions/methodologies and *internal sources of innovation,* and the *decentralised approach* supports acquisition, capitalisation/reuse, transfer/sharing of knowledge and *generalisation* of knowledge; it is successful in terms of customisation, customer satisfaction, innovativeness of the solution, people performances (sense of belonging, work satisfaction, self esteem and reduction of labour turnover) and knowledge performances (use of spare time to generate knowledge-B3-use of business activities as opportunities to generate knowledge-B2).
P2.4 If a consultancy company adopts a strategy based on external sources of innovation (playing an process role with the customer) and implements knowledge management configurations which do not support the generalisation of knowledge about solutions but do support the development of knowledge about methodologies and motivations (even in a contingent form); it is successful in terms of innovativeness, customisation of solutions and methodologies, margins and self esteem.
P2.4.1 If a company adopts an innovation strategy based on *exploration* of solutions/methodologies and *strong involvement of the customers,* and the *decentralised approach* supports acquisition, capitalisation/reuse, transfer/sharing of knowledge, but not generalisation of knowledge; it is successful in terms of innovativeness, customisation of solutions and methodologies, people performances (sense of belonging, work satisfaction, self esteem and reduction of labour turnover) and knowledge performances (use of spare time to generate knowledge-B3-use of business activities as opportunities to generate knowledge-B2).

6.5 SUMMARY AND CONCLUSIONS

In this chapter, the second research question has been addressed, in terms of relationships between the innovation strategies of consultancy companies and the knowledge management configuration implemented, and a set of propositions has been derived. In particular, results concerning the association between innovation strategies and knowledge management configurations have been found and a set of propositions have been based upon them.

However, some points still remain unresolved:

- Firstly, most of the analysis about contingencies in this research has focused on innovation strategies. However, as noted in Chapter 5, other contingent variables also seem to influence the specific knowledge management configuration. For instance, the *size of the company* and the level *of dispersion of its activities* are two variables that can drive the choice of a specific approach to knowledge management. Similarly, the level of *labour churn* is a clear constraint that companies have to consider in the implementation of the knowledge management system. For example, a very high labour turnover is critical for companies adopting a decentralised approach (Hansen et. al., 1999). Therefore, further steps of the research should focus on a systemic contingent analysis of knowledge management approaches (Chapter 9).
- A second important issue that emerges from the explorative research at this stage is the possibility of developing a dynamic approach to knowledge management. As discussed in Chapter 5, case studies provide a picture of the investigated variables at a certain moment, and do not provide insights into the dynamic interaction between innovation, other contingencies, knowledge processes, and knowledge management. Moreover, some of the companies highlighted ideas to further improve their knowledge management configurations, as examples: company A indicated the intention of facilitating the integration of knowledge stored by individuals; company C and G are working on the rationalisation of their knowledge base, providing a form of structure to the knowledge owned by individuals; and company D has established a strong relationship with a company implementing solutions in order to internalise the knowledge about the overall project.
- The analysis of knowledge management configurations over time increases the understanding of:
  - The evolution of the internal knowledge management configuration: what changes occur within the overall configuration if one of the levers changes? In particular:
    - The role of ICT: what changes to organisational mechanisms and managerial systems are fostered by a change of ICT functionalities?
    - How are these changes managed within the organisation: what are the barriers and enablers of these changes?
    - What are the effects on performances, namely: the knowledge processes, people and business performances?
  - The effects of change in the knowledge management configuration on innovation strategy. In this chapter, the innovation strategy has been considered as a contingent variable, and the association between strategy and the knowledge management approach investigated. One interesting research question at this stage concerns the analysis of the opposite argument: can the implementation of a specific configuration of levers foster a new innovation strategy? In order to answer this we need to move from a contingent approach to dynamic research. (see figure 6.8).

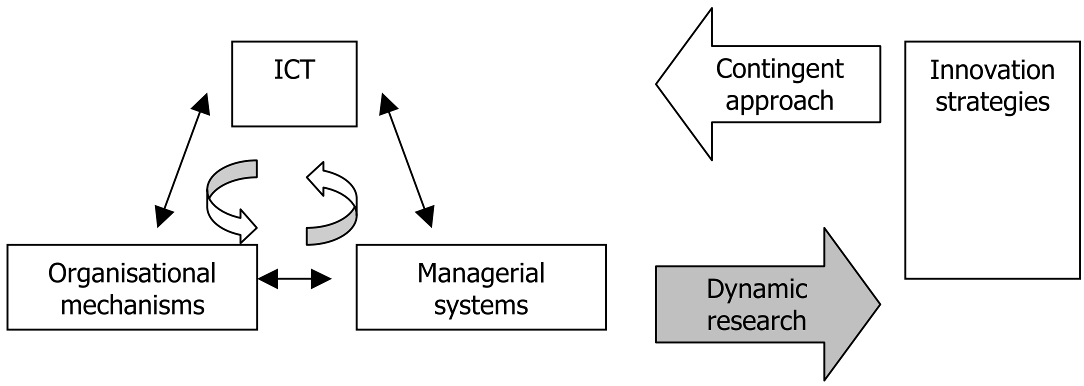


Figure 6.8: The focus of the dynamic research

The dynamic research developed in this thesis is focused on the analysis of the dynamic interplay between innovation strategies, and knowledge process and knowledge management configurations, in order to develop insights about the evolution of knowledge management.

The analysis of variables can be approached using longitudinal cases (Chapter 7), implying the analysis over time of variables in the framework (levers, behaviours, performances and contingencies). Such an analysis is extremely useful for refining propositions resulting from static case studies, especially when focusing on changes in the framework due to changes in ICT functionalities. The output of this dynamic research will be formalised in a set of revised propositions. A more participative approach, such as action research, allows the combination of the "time" dimension of analysis with the participation of the researcher. This approach will be followed in Chapter 8.

CHAPTER SEVEN: REFINING THE RESULTS THROUGH THE LONGITUDINAL CASE STUDIES

7.1 INTRODUCTION

In Chapters 5 and 6, RQ1 and RQ2 were addressed. This has resulted in the confirmation and operationalisation of the preliminary framework for knowledge management in innovative environments, the confirmation of existence of successful internal configuration of levers (centralised, oligarchic and decentralised approaches) embedded in theory, and their association with specific performance and innovation strategies in the consultancy industry. Some other issues need to be discussed in order to refine these results and fully answer the research questions:

- Firstly, concerning the *application of results to other industries*. The configurations developed so far mainly come from empirical analysis, and their functionalities have been explained through theory. It would be interesting to see if these configurations also emerge in other knowledge-intensive professional companies. Thus, a refinement of the propositions resulting from RQ1 will be carried out in terms of limits of their applicability.
- *Alignment*. In Chapter 6, the association between configurations and innovation strategies has been identified in successful companies. This result can be refined by investigating performances in the event of a missing association. The outcome will contribute to fully answering RQ2.
- *Changes over time*. This is related to RQ3: in particular to changes in the functionalities of ICT, and their effects on the overall configuration, on performances, considering the role of contingencies.

Section 7.2 describes the methodology adopted in order to address these research topics (both the static and longitudinal cases), Section 7.3 describes the research setting, Section 7.4 is focused on RQ1, Section 7.5 on RQ2, and finally Section 7.6 addresses RQ3.

7.2 THE RESEARCH METHODOLOGY

The development of two further case studies (Company I and L) is intended to meet explorative goals. As represented in figure 7.1, several steps characterise this investigation:

1) *Explorative phase,* with the same investigation questionnaire and protocol as in the previous cases. In particular, the researcher, when interviewing the managers, sought out the main characteristics, strategy, knowledge processes, levers, and performances. Moreover, the managers of the companies were more actively involved in the analysis than in the previous case studies: they collaborated with the researcher in collecting feedback from employees throughout the organisation on the usefulness and usability of the knowledge management system in supporting knowledge processes. Managers and researcher gathered this information through interviews and, in one of the two cases, through the use of a short questionnaire (appendix 5) on the Intranet concerning the

knowledge management system and the level of satisfaction in its use. This feedback from the employees contributed to collecting data, and to checking the results from the interviews with managers.

2) The second stage concerned the *development of suggestions for improvements* (in terms of new levers in the configuration). The researcher presented the results of the case study in their own company to managers during workshops, and asked them to identify possible suggestions for improvements (and solutions to implement deriving from them). Their reactions and intentions to implement these improvements have been questioned. The suggestions for improvement concerned, in both the companies, new ICT functionalities (Section 7.3).
3) Finally, after some time (approximately six months in both cases) an *exploration of the new configuration* took place in the companies, and the effects on the organisation assessed. The analysis was performed through discussions with managers in order to see whether the configuration was implemented and what the reactions were, the effects in the organisation and on performances, and if there were any further evolutions.

The methodology adopted is summarised in figure 7.1.

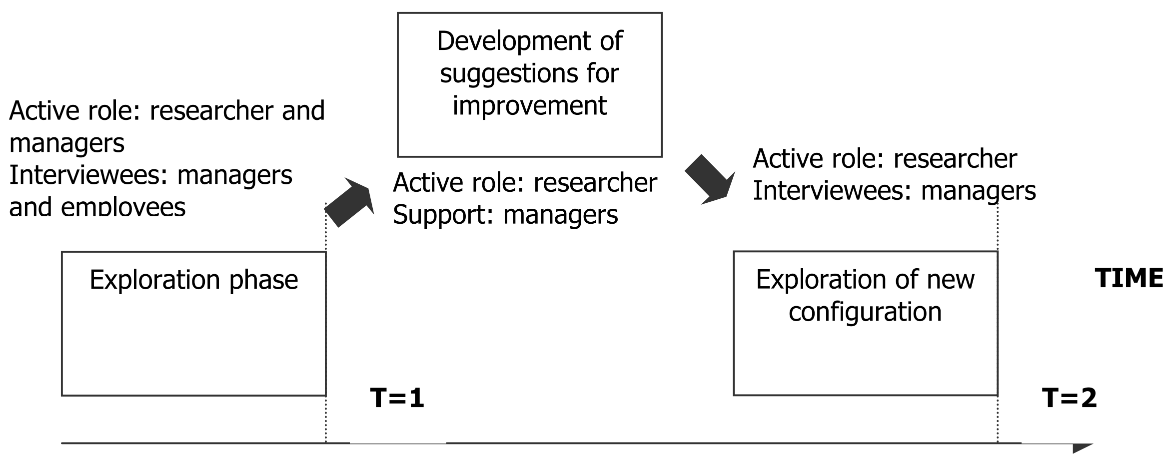


Figure 7.1: The development phases of the longitudinal cases

Another issue concerns the roles of the researcher and managers involved in the different stages of the analysis. As represented in figure 7.1, the researcher is almost always the only one playing an active role[10]. Managers are either interviewed or support the researchers in collecting data, especially during the first explorative phase. This strict relationship between the managers and the researcher provides an opportunity to build construct validity into the research (Yin, 1994). In action research (Chapter 8), on the other hand, the researcher does not always play the active role (Adler and Shani, 2001).

In the next section, a brief description of the cases, and of their peculiarities compared to consultancy companies, are highlighted.

[10] In line with case study theory (Yin, 1994)

7.3 THE RESEARCH SETTING

The prime goal of this section is to describe the main characteristics of the two telecommunication companies involved in the investigation in order to highlight their similarities and differences with the eight consultancy companies.

Company I

Company I operates in 115 countries and is a global leader in the networking market. From its early beginnings, Company I developed a growth model based on the acquisition of existing companies. These were subsequently integrated into its global range of networking products and services, in order to reflect company I's standards in terms of quality, technology, information systems and communication. In recent years, Company I has entered the optical business, and one of the many acquisitions in this field is a Business Unit of a leading Italian company. The case study focused on the integration of the sales people from the old company into the new Business Unit. Even more incumbents and new players in the sector require Company I to shift its business focus from hardware selling to total solution and service. This requires stronger competencies in the sales people in terms of problem-solving capabilities and integration with the other parts of the organisation (e.g. marketing and business development). The research setting is the selling force of the Italian company, before and after the acquisition by Company I.

Company L

Company L operates worldwide in the mobile phone industry (the focus of the case is on software development activities). Its activities are geographically distributed and currently it has developed sites in several countries in Europe, the USA, and Japan. Each development site has the chief responsibility for certain products, but the sites have to co-operate quite extensively. The complexity of the product family, the structure of the development organisation, and the market pressure in terms of price, performance, and rapid need to introduce new features as they become available in the networks, make mobile phone software development a very challenging task.

Within the software development process, some specific subprocesses have been investigated in order to carry out the analysis: 1) the organisation and management of software reviews, 2) global helpdesk for establishing a configuration management system, 3) global release management[11]. Each one of these processes, taking place in a distributed, multi-site project, presents the need for support in order to facilitate the acquisition, transfer and sharing, and capitalisation and reuse of required knowledge. Moreover, all the three subprocesses within software development are *relevant* for the performance of the overall process and they *well represent the complexity of the overall process* in terms of goals and actors involved. The case study is also a part of an EU project aimed at developing and implementing, in two companies, an ICT tool

11 The key characteristics of the subprocess of conducting peer reviews: peers conduct walkthroughs when the work product is created and confirmed as ready for walkthrough. Knowledge relevant to perform this activity comes from the team itself and from similar projects. Global helpdesk for configuration management, on the other hand, includes the collection of experiences from experts at the different sites, the establishment of a configuration system for the current project, and the establishment of a configuration control board. The global release management, aims to release the project's software for formal external, formal internal, or informal use.

in order to stimulate knowledge processes for dispersed workers (Motion project, deliverable D 1.2). In selecting the processes, the feasibility of the application tool was also to be considered.

In figure 7.2, the main similarities and differences between companies I and L and the consultancy companies A-H are summarised:

	Companies A-H	**Company I**	**Company L**
Characteristics of product	Management consulting services	Very complex technological product in terms of number and technologies of the different modules.	Very complex technological product. Focus on software.
Analysed business processes	Service development: analyses of customer requirements, offer preparation, design of the solution and implementation Knowledge-intensive work	Product sales process: analysis of customer requirements, offer preparation, integration with R&D and operations for design and delivery Knowledge-intensive work	Software development and, in particular, the organisation and management of software reviews, global helpdesk for establishing a configuration management system, global release management. Knowledge-intensive work
Output of the business process	Service and Knowledge	Discrete product	Software
Relationship between knowledge and business processes	The knowledge process is the core process of the company as its output is directly sold to the customer	The knowledge process is not the core process, but it extremely important for the performance of the business process, as knowledge is directly incorporated in the product (in terms of new configuration/architecture or solution)	The knowledge process is not the core process, but it extremely important for the performance of the business process, as knowledge is directly incorporated in the product (in terms of new configuration/architecture or solution)
Characteristics of people addressed by knowledge management system	Managers and consultants involved in business process and knowledge processes. They are dispersed and they work in team in collaboration with the customer. Employees	Sales people involved in business process and knowledge processes. They are dispersed. Employees	Managers and R&D people involved in business process and knowledge processes. They are dispersed and mobile. Employees
Focus of the case	Overall company Selection of projects, which represent the activities of the company.	Specific process: sales	Specific process: software development Focus on relevant and representative subprocesses.
Level of consolidation of knowledge management activities	Consolidated	Consolidated in Company I, not consolidated in the Italian company before acquisition	Not very consolidated

Figure 7.2: Main characteristics of company I and L, compared to A-H

The process of developing the stages of analysis in the two companies is represented in figure 7.3:

- In order to answer RQ1: Company I was investigated at T=0 and T=1. Configurations I.1, I.2 and I.3 will been discussed in Section 7.4. Company L was investigated at T=1 (configuration L.1).

- In order to answer RQ2: Company I was investigated at T=1 (configuration I.3), and Company L again at T=1 (configuration L.1).
- In order to answer RQ3 the changes due to the implementation of new ICT functionalities in the configuration of both companies, from T=1 to T=2, are analysed and discussed.

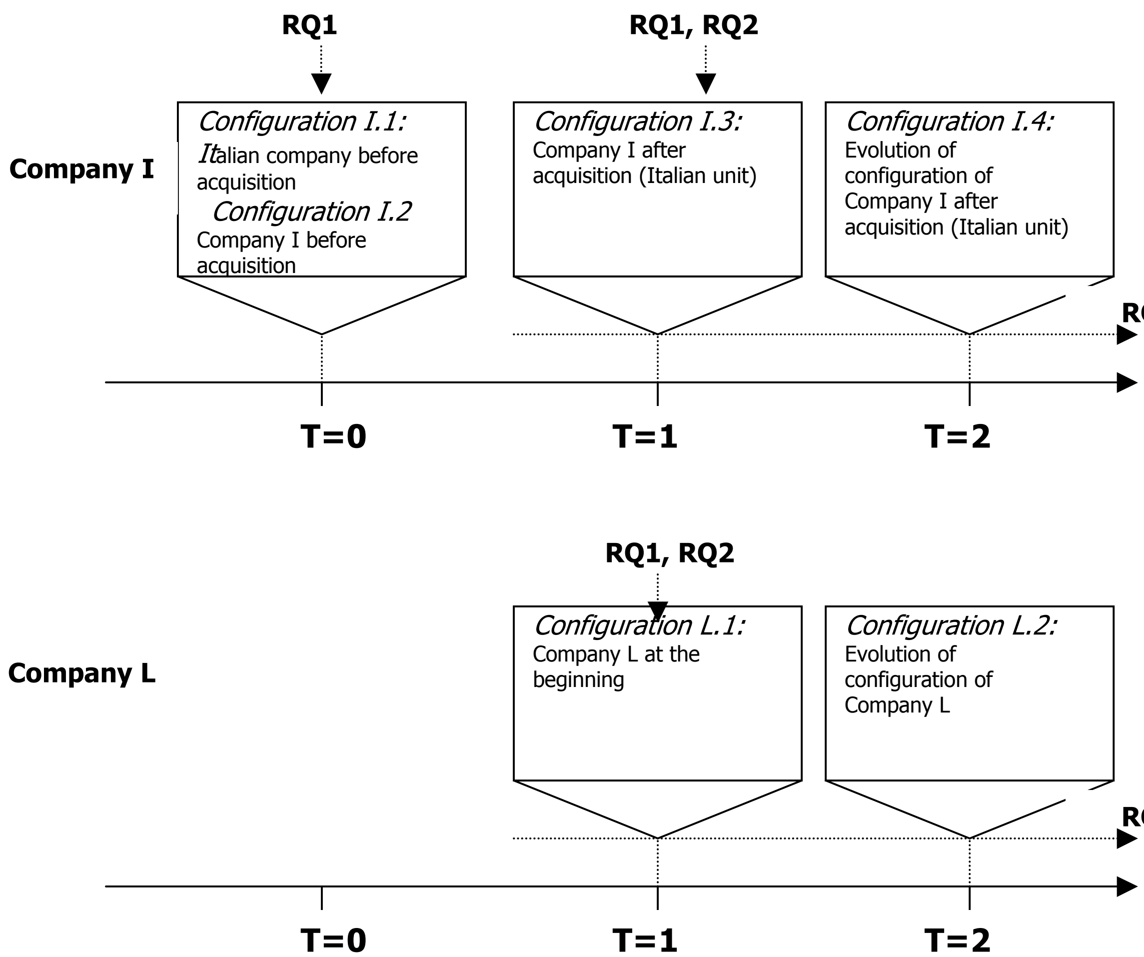


Figure 7.3: The configurations analysed in the two cases

7.4 THE ADOPTION OF KM CONFIGURATIONS IN OTHER PROFESSIONAL ENVIRONMENTS

The main goal of this section is to validate the results of Chapter 5 also in other professional knowledge-intensive organisations (RQ1).

Research question

The subquestion relevant for this part of the research is RQ1.5[12]: are the configurations of levers adopted in consultancy companies also valid in other knowledge-intensive industries?

For this, the knowledge management configuration implemented in company I and L need to be investigated, in particular:

- Which functionalities of levers foster knowledge processes in Companies I and L?
- Which KM configurations (in terms of ICT, organisation and management tools) are implemented? Are they coherent with the configurations derived from empirical analysis in Chapter 5, and explained through theory?
- What are the performances of these configurations?

Analysis of the cases

Company I

The Italian company, before its acquisition, (Configuration I.1) did not rely on specific ICT tools in order to foster knowledge activities. People used to communicate through traditional means such as phone, fax, and email. The size of the company, and the possibility of frequently meeting each other in training courses and meetings, used to facilitate direct knowledge transfer and sharing among the account managers. Moreover, their role was widely recognised throughout the company, and they used to interact very easily with R&D and operations in order to generate solutions for the customer. Although using very basic levers, knowledge processes were enhanced within the organisation: account managers were delegated with all the knowledge management activities to be carried out, together with business activities (high horizontal and vertical decentralisation). The main coordination mechanism among the account managers was mutual adjustment, facilitated through simple but effective communication tools. Knowledge, which consisted of experiences in terms of solutions adopted, methodologies and procedures, was therefore accumulated tacitly through the direct interaction with customers, and then made explicit and transferred through communication tools. The functionalities of the levers implemented reflected the characteristics of the *decentralised approach*. The effects on the performances of knowledge processes were positive: people frequently used to transfer and share knowledge accumulated in their personal selling experiences, and generated knowledge concerning customers and selling procedures (also relating with other functional units within the organisation). From the quality of working life perspective, they recognised their role in the business and knowledge processes, and the level of turnover was extremely low.

Conversely, Company I is a large global company, characterised by the adoption of a centralised approach (Configuration I.2) to knowledge management. Company I is widely recognised as a leader in terms of the quality and completeness of knowledge provided through its Intranet. The company's web connections are a combination of Internet and Intranet applications, which are available to customers, employees, and partners. Company I's Intranet is designed to provide information and services to meet the needs of the employees (knowledge and interactive tools for facilities, travel arrangements, technical documentation,

[12] The first research question is "What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge-intensive, innovative environments, and which performances are related to them?"

human resources, training, sales, marketing, and financial matters) categorised by lines of business, business functions, and company and employee–related information. There are also a number of repositories, called "dashboards" groups, which link on particular topics ("new hires", job specific tools, new products…). From the organisational viewpoint, it is important to note that the content of the Intranet is managed at a world level: a team of people in the U.S. is in charge of maintaining the structure of the Intranet. Knowledge coming from the individuals in the organisation is organised by a centralised unit for knowledge management, and then published on the Intranet. As a consequence, the horizontal decentralisation of the configuration is so extremely low, and knowledge workers (in this case account managers) are only involved in reusing knowledge accessible through the Intranet. The knowledge base includes solutions and methodologies/procedures in explicit, and usually generalised, form. The coordination mechanism is standardisation: people have clear outputs and procedures they have to follow in order to carry out their business and knowledge activities. The functionalities described reflect the levers of the *centralised* approach. The effects of the configuration can be observed in people behaviours: people very frequently capitalise knowledge on the Intranet, and retrieve it for application in new processes. Nevertheless, knowledge is not generated that frequently, while analysts perform abstraction and generalisation. However, account managers do recognise their roles as they are rewarded according to their business results, and these can be significantly improved through using the knowledge management system, as the retrieval of solutions becomes much more efficient.

After the acquisition of the Italian unit by Company I (configuration I.3), the knowledge management system implemented aims to support the integration of optical products developed in the business unit with the rest of the company portfolio (with specific reference to optical portfolio) worldwide, facilitating the creation of an integrated sales force for optical and traditional products, improving the competencies of new account managers in the optical products, and in selling "total solutions". Company I has also decided to adopt a centralised approach for managing the knowledge of the sales people in the new business unit. The new organisation of the selling process involves several roles. *Accounts Managers* are the customer's "owners". Most of them do not have a strong technological background concerning optics as they used to sell the historical products produced by Company I. The evaluation of their activities, and consequently their reward system, is linked to gross sales margin: a result of which is that their efforts are dedicated to those products with the highest margin and which are easiest to sell. These are the traditional networking products (available on a catalogue) and not the optical products. *System Engineers* are the technical interface of the account managers for what concern the system configuration. *Sales Overlay* represents the most technical component of the selling chain. Most of this layer is made up of the acquired company's personnel, who previously acted as account managers providing to the customer with complete ad hoc optical solutions based on their own knowledge plus knowledge from the internal R&D unit. Following the acquisition, account mangers have been replaced by Company I employees, and previous account managers, given their knowledge on the product, act as business "consultants" for them (i.e. the sales overlay). The knowledge base available to all the sales people is vast (and can be accessed through the Intranet). However, problems have been described by new account managers: firstly, it is difficult to access really useful knowledge about optical products through the Intranet, this is related to the lack of time for searching, their background about networking products, and the role of sales overlay. All knowledge concerning the process of selling optical products by the Italian company is accumulated in a tacit form by sales overlay. Due to time and margin pressure, the account managers mainly focus their activities on networking products and, when necessary, they consult sales overlay directly though phone calls and email.

From the managerial systems perspective, at this stage, the organisation has not yet recognised the possibility of sales people directly contributing to the knowledge base. The result is that sales people see their role and their career paths exclusively in terms of performing sales. This is critical for sales overlay, whose main contribution to the selling process is in terms of accumulated knowledge about product and customer that has to be retrieved by new account managers. This configuration, therefore, presents some critical issues, concerning:

- The choice of the company to adopt a specific knowledge management configuration. In carrying out the process of acquisition, Company I decided to align the knowledge management configuration of the Italian company (I.3) to the one already adopted by the rest of the organisation (I.2). The culture of the overall organisation, and its strategic priorities, constituted a constraint in the choice of knowledge management configuration.
- The alignment of the knowledge management configuration with the innovation strategy (Section 7.5) of the considered unit. This issue is particularly clear in terms of the type of knowledge retrievable from the knowledge base, and the goals of the sales people (to sell both optical and networking products).
- Certain barriers to change that have not been identified by the managers of Company I (Section 7.6).

Company L

The knowledge management configuration implemented in Company L (configuration L.1 in T1) reflects the functionalities of the *decentralised approach*. In terms of ICT, the most often used tool for information acquisition, transfer and sharing is email. Also, Lotus Notes, Intranet, PCMS (a configuration management system) and phone were used. Some of the interviewed people stated that the most effective way to gather and share information was to have conversations with people, for example in corridors, and therefore personal networking was also ranked very highly as a medium through which to acquire information. Others said that personal networking is, in practice, the best way to effectively get information because Lotus Notes and Intranet, in their present form, are ineffective in searching knowledge while personal networking was faster and more successful.

Considering the organisational mechanisms, which characterise the configuration, people are not appointed to specific knowledge-processes roles: people involved in projects have a second role in knowledge processes. Nevertheless, due to the increasing number of multi-site projects, the company, in order to facilitate knowledge sharing, has defined "tutors". Tutors are a sort of gatekeeper at each site: they facilitate the knowledge transfer from one site to another, and are the contact point at each company site for acquiring or transferring knowledge from and to other sites. They do not have formal power, but they are facilitators of knowledge processes. These organisational solutions are characterised by high horizontal and vertical decentralisation, as everybody in development processes (and especially in the subprocesses analysed in the case study) is involved in knowledge activities.

In terms of managerial systems, Company L has implemented plans for knowledge management: when considering their software development projects, a plan for knowledge transfer and sharing is prepared at the beginning. This solution has been characterised by the company as unsuccessful in some cases. In innovative projects, for example, it was difficult to specify activities where knowledge could be ready to be transferred, shared and retrieved by a different project.

Certain managerial systems can be referred to as product platforms (referring to software development) and the organisation of the process (concurrent engineering). The product platform can be considered as a coordination mechanism which standardises some of the results developed by the teamwork (Corso et al., 1996; Sanderson and Uzumeri, 1995): in other words knowledge developed by the team has to be referred to as a common body of knowledge- the product platform. Similarly, concurrent engineering provides the opportunity to exchange knowledge between functional units and, at the same time, it is related to procedures implemented to facilitate such knowledge exchange (Bartezzaghi et al. 1997; Rosenthal, 1992). These managerial systems are aimed at establishing particular topics (as the product platform issues) and occasions (moments in the process) to foster people to collaborate and communicate. The main vehicles of knowledge at this stage are relational since they are based on interaction among people.

The performances of the knowledge process can be assessed according to different dimensions: referring to *knowledge process effectiveness*, the configuration, at company L, is rather successful in terms of transfer and sharing of knowledge within the project, as both the procedures and the implemented concurrent engineering practices facilitate this activity. Greater difficulties have been encountered in assessing knowledge transfer and sharing between projects, people operating in other projects are not known or recognised as experts in specific topics. Moreover, people are very much involved in knowledge generation and experimentation with new solutions. In terms of *people performances,* the main results from the measurements are: high team spirit, satisfaction with collaboration and ease of getting knowledge within the projects. The team working on each project is successful, and this leads to highly innovative ideas for the products, and innovative solutions for the product coming from the collaboration. Nevertheless, two main areas for improvement have been identified: first of all in collaboration among projects, and then in providing feedback of the results of knowledge transfer since this is extremely useful for learning. Company L is also rather successful also in terms of business performance: the quality and reliability of the product are widely recognised, but the time to market associated with its products is still too long.

Moreover, through the interviews, a change of the external characteristics of the context has been raised: the company described the increased level of dispersion of activities, and the stress of new product development performances (in terms of time to market and innovativeness of the solution developed), as extremely critical. Managers, in fact, raised possible improvements in the configuration in order to facilitate collaboration within and among teams of dispersed workers. The functionalities of levers implemented can become not sufficient to support knowledge processes.

Discussion of results, conclusions and propositions

The goal of this subsection is to interpret the cases studies at Companies I and L, comparing the validity of results with other professional knowledge-intensive industries.

The configurations mapped through the case studies are summarised in figure 7.4. For each configuration described in the previous subsection, the implemented levers (in terms of functionalities supported and solutions adopted) are shown. Moreover, the characteristics of the configuration, in terms of horizontal and vertical decentralisation, coordination mechanisms, and type of knowledge supported, are highlighted. Then, the performances detected are outlined.

	ICT	*Managerial systems*	*Organisational mechanisms*	*Configuration*	*Performances*
Configuration I.1: Italian company before acquisition	Communication through traditional means: phone, fax or email	Same as business activities	Diffused responsibility: people play a dual role	Decentralised approach: high vertical and horizontal decentralisation Coordination mechanisms based on mutual adjust., focus on tacit methodologies and issues	-Frequent transfer and sharing (B4 and B5), generation (B2 and B3). -High satisfaction in work -High loyalty of the customer
Configuration I.2: Company I before acquisition	Storage and retrieval through Internet and Intranet services. Huge knowledge base	Rewarding systems based on business activities results	Standardisation : a group of people dedicated to knowledge management activities	Centralised approach: low horizontal decentralisation and medium vertical decentralisation, coordination mechanisms based on standardisation of work processes and output, focus on explicit solutions	-Frequent generalisation (B6) and embedment into vehicles (B7) -Good use of time -High turnover and gross margin
Configuration I.3: Company I after acquisition	Storage and retrieval through Internet and Intranet services. Huge knowledge base	Rewarding systems based on business activities results	Standardisation : a group of people dedicated to knowledge management activities Role of sales overlay	Centralised approach: low horizontal decentralisation and medium vertical decentralisation, coordination mechanisms based on standardisation of work processes and output, focus on explicit solutions	-Poor generalisation (B6) and embedment into vehicles (B7). Rather frequent transfer and sharing (B4 and B5). -High labour turnover -Low loyalty of the customer
Configuration L.1: Company L	Communication and collaboration through conferencing facilities; knowledge exchange and co-working facilities	Plan for knowledge transfer, concurrent engineering	Diffused responsibility: people play a dual role. Role of tutors	Decentralised approach: high vertical and horizontal decentralisation, coordination mechanisms based on mutual adjust, skill standardisation and output standard, focus on methodologies and issues	-Frequent transfer and sharing (B4) and generation (B2 and B3). To be improved all the others (especially B5). -To be improved innovativeness and time to market

Figure 7.4: The KM configuration of companies I and L

From the analysis of the case studies, some observations can be made. Firstly, *the configurations are characterised by the functionalities of levers, (and their relative forms),* identified and described in Chapter 5 as centralised (I.2 and I.3) and decentralised (I.1 and L.1) approaches. In particular, the decentralised approach, in both companies, emphasises the recreation of the *context* for knowledge management. ICT, in this approach, is a communication and collaboration means, and it is a prerequisite for recreating the missing context resulting from having dispersed workers. However, it is not enough to foster knowledge processes: the organisational mechanisms and managerial systems have to support the horizontal and vertical decentralisation in terms of structure, roles, responsibilities and coordination mechanisms (in particular incentives). The centralised approach, on the other hand, is focused on the *content*: people contribute in building a knowledge base, which is usually managed and updated centrally (low horizontal decentralisation). ICT then supports the asynchronous retrieval of accumulated knowledge.

In the analysis of each configuration of levers, certain characteristics of the new research setting emerged, which explain some of the specific choices made by the companies. Starting from the characteristics of the research setting (figure 7.2) three elements mainly distinguish it from the previous one: 1) the focus on functional units instead of the overall company projects 2) the focus on processes where knowledge is not the core output but is embedded into products clearly determining their quality; and 3) the level of consolidation of knowledge management practices.

- The first difference raises the issue of the *relationship between the functional unit and the overall company*. Organisational mechanisms, managerial systems, and ICT are usually not decisions of the functional unit, and not completely developed within the budget of this unit: they are usually integrated with the overall decisions at the company level. For example, in the case of Company I, the choice to rely on the KM system of Company I was taken at the company level, and not in the new business unit. The team of analysts was already established at a company level, and had no relationship with the knowledge of the new business unit. Similarly, as will be discussed in the longitudinal analysis of the cases (Section 7.6), in both the companies, when possible improvements were suggested, the solutions chosen required only changes in the levers within the functional unit. For example, managers operating in the software development unit of company L decided to participate in an EU project, aimed at experimenting within the functional unit with new collaboration tools, in order to improve the functionalities of the overall KM system. This participation was agreed with the IT unit of the company, but the changes in organisation and managerial systems required decisions only to be taken at the functional unit level. This means that the organisational, technological and managerial solutions determined at the company level influence the choice of the functionalities of levers to be implemented to foster knowledge processes in a specific functional unit. This issue becomes even more critical when the situation concerns a multinational company and where organisational practices, values and cultures are different in the subsidiaries (Hofstede, 1980; Corso et al.1998). In Company I, for example, it was pointed out how the sales people in Italy had a lower familiarity with web tools than the Americans. This has been seen as a strong barrier to the adoption of configuration I.3 (barriers to change will also be discussed in Section 7.6 when considering the analysis of configurations over time).
- The issue concerning the role of knowledge in the final output of the process, raises the question of relationship between *knowledge processes and operational processes,* and the related levers. In the

two companies, levers implemented to foster knowledge processes in most cases are the same levers used to foster operational processes. This is especially true in the case of decentralised approaches where everyone in the processes plays a dual role: the issue of *formalisation of the knowledge process*, in terms of goals (explicit or implicit goals) and control of effectiveness of knowledge processes by managers, becomes critical, especially when the functionalities implemented do not support the new requirements of the knowledge processes (as was the case in Company L). If the relationship between knowledge and operational processes is close, it is important that managers are aware of the importance of formalising goals for knowledge processes and that they constantly control the level of performance. If not, the operational process activities can be a constraint to knowledge activities, for example in terms of time pressure and available slack (Gieskes, 2001).

- The partial overlapping of levers in the operational processes and in the business processes can be partially explained also through the *level of consolidation of knowledge processes* in the companies. Knowledge management topics are now becoming a critical issue for companies that in the past were more focused on managing operational processes. It is possible to introduce the "evolution of knowledge management systems" scenario, which can be explained only through a longitudinal (or action research) approach.

Moreover, in terms of the *effects of the configuration on performances* as reported in figure 7.4, it emerges that configurations I.1 and I.2, closely reflect the same dimensions of performances as reported in Chapter 5 for decentralised and centralised approaches. Configurations I.3 and L.1, on the other hand, have the same lever functionalities of centralised and decentralised approaches, but the performances show relevant areas for improvement. This raises the question as to whether the configuration is aligned with the innovation strategy or not (Section 7.5).

Based on these results, a set of propositions can be derived. The first six propositions concern the generalisation of propositions derived from the consultancy companies' results[13].

P1.1 (g) In professional knowledge-intensive organisations, if a specialist unit for knowledge management is set up within the organisation, coordination of knowledge management efforts is formalised through the standardisation of KM practices (i.e. procedures). The application of these practices is supported by specific knowledge management roles in the organisation, and by ICT storing and transferring solutions and methodologies in an explicit and generalised form. (Centralised approach)
P1.3 (g) In professional knowledge-intensive organisations, if knowledge management is a diffuse responsibility, every worker has a dual role of performing process and knowledge management activities. Explicit managerial methodologies are implemented to foster and assess learning throughout the organisation. ICT mainly supports synchronous collaboration among teams (decentralised approach).
P1.5 (g) In professional knowledge-intensive organisations, if a company adopts a centralised approach, then it is successful in terms of time to market, efficiency (business performances), high sense of belonging and the use of time (people performances).
P1.7 (g) In professional knowledge-intensive organisations, if a company adopts a decentralised approach, then it is successful in terms of customisation and customer satisfaction, innovation of the solution

[13] The propositions indicated with the (g) are the ones generalised through the analysis of Companies I and L. The cases concerns only centralised and decentralised approaches. However, it could be assumed that the propositions concerning the oligarchic approach are also valid in professional knowledge-intensive environments.

(business performances), work satisfaction, sense of belonging, self esteem and reduction of labour turnover (people performance).
P1.8 (g) In professional knowledge-intensive organisations, if a company adopts a centralised approach, then knowledge is strongly embedded in technological vehicles.
P1.9 (g) In professional knowledge-intensive organisations, if a company adopts a decentralised approach, knowledge workers are very much involved in seeing their activities as opportunities to develop knowledge, and to use their spare time to generate knowledge.
P1.14 If the scope of the knowledge management system is a functional unit, then the values and culture of the company, influence the choice of the configuration and its effects on performances.
P1.15 In a professional knowledge-intensive organisation, the use of the same levers to support both business and knowledge processes is a constraint to knowledge activities in terms of time pressure and available slack.
P1.16 If a professional knowledge-intensive organisation which uses the same levers to support both business and knowledge processes, implements a decentralised approach and formalises knowledge processes, in terms of definition of knowledge processes goals (explicit or implicit) and knowledge processes performances control, then it is successful in terms involvement of knowledge workers in seeing their activities as opportunities to develop knowledge (B2) and in the use of spare time to generate knowledge (B3).

7.5 THE ANALYSIS OF THE ALIGNMENT BETWEEN INNOVATION STRATEGY AND CONFIGURATIONS

In Chapter 6, the association between knowledge management configurations and innovation strategies was discussed, with the analysis focused on successful companies operating in the management consulting industry. This section is focused on RQ2, investigating the alignment between innovation strategies and knowledge management configuration.

Research question

As discussed in Chapter 6, RQ2 can be formulated as "Is a particular KM configuration aligned with a specific innovation strategy?" To be more specific:

RQ2.1 Is a KM configuration associated with a specific innovation strategy?

RQ2.2 Does an innovation strategy influence the success of a knowledge management configuration?

Alignment implies that a relationship between innovation strategies, KM configuration, and performances exists. Therefore, the second subquestion focuses on cases of poor performances where such an association is not in place: if the missing association between innovation strategies and knowledge management configuration can explain the level of performances, then the innovation strategy influences the success of the knowledge management configuration (alignment).

Analysis of the cases

Company I

The level of innovation of a company is related to the level of exploration of new solutions and technologies versus the exploitation of currently available solutions. The level of involvement of external sources represents the extent to which external actors take part in a company's business processes (Zack, 1999c). These actors are suppliers, customers and other companies or institutions (Afuah et al., 1995). Considering the innovation strategies of the Italian company, before the acquisition by Company I, the account managers used to work together with the customer in order to develop and sell "total solutions". Moreover, they owned a high level of knowledge of the product, and used to directly interact with the more technical people within the company in order to provide the best solution for the customer. Due to the high technological level, account managers had to closely collaborate with R&D and the customer in order to provide a solution that fitted the specific requirements. In performing their activities, they improved and innovated the product, as the solution provided has to reflect customer needs and technical requirements. It is possible to consider their activity as a "product innovation phase" (Bartezzaghi et al. 1998). The role of the customer is also very important in the development of the solution, as the product specifications are negotiated between sales people, who carry out their activities in collaboration with the R&D unit, and the customer. Among its strategic priorities, the Italian company, before the acquisition by Company I, identified the innovativeness of the product and customer loyalty, especially achieved through identifying and satisfying customer requirements.

After the acquisition, Company I strongly encouraged the use of the knowledge base available through the Intranet. The strategic priorities of sales people are related to total gross margin, which can be enhanced through selling products available on catalogue. The key competence of sales people changes, from providing total solutions, to interpreting customer needs and selecting the available product that best fits these requirements. The level of innovativeness embedded in this activity is much lower than before. This does not mean that the level of innovation of products developed by Company I is low, but that it is mainly determined by R&D unit activities, and selling people are not contributing significantly. Similarly, the level of involvement of external sources (the customer) is reduced to the identification of requirements. In this context, the various roles (new account managers and sales overlay staff) perform different tasks in the knowledge management system: account managers are in charge of directly selling the products, and they do not play any innovative role in the business process. On the other hand, sales overlay stores the knowledge on the development of "total solutions". This knowledge concerns the solution itself, the methodology with which to approach the customers, and the development of a solution for them. The structure of the knowledge base does not catch these issues as it is only designed to support knowledge about networking products and optical products developed in other business units. The effects on knowledge processes performances are twofold: first of all account managers focus their selling activities on the knowledge available through the Intranet, with knowledge about methodologies and total optical solutions not stored in the knowledge base, and, secondly, when necessary, traditional communication tools are used to approach the previous account managers.

Company L

In terms of concerns Company L, it emerged during the case study that the growing level of globalisation of activities made it more difficult to rely on current levers of knowledge management to perform knowledge activities. In recent years, Company L has changed its strategy towards a stronger involvement of external actors in their R&D activities: external sources of knowledge, in terms of suppliers, other research centres, and different teams. The knowledge management system was based on the communication and collaboration functionalities of ICT, and these became insufficient to support the new dispersed worldwide setting. Storage functionalities of ICT were available (i.e. Lotus Notes) but not used, as documentation was not organised, maintained and used by work teams particularly because of difficulties in identifying its relevance and context in a dispersed environment. Limits of the current knowledge management approach were emphasised in the new setting: in particular people pointed out difficulties in acquiring knowledge from other projects and, within the project, of getting feedback about results of knowledge provided.

> *"I can feel sometimes that projects do not want to tell me all the needed knowledge straight away. There is a clear border what is told and what is not told. Because I am not a 100% member of any project, and I just gather knowledge from different projects, I too often meet this selective information sharing just because I am not a member of a project." (Product manager, distributed project, seven years in company L)*

> *"It is usually very difficult to locate information and find out who has that information. Even inside our own unit, it is difficult to know what is happening and what kind of projects are running. One reason for these problems is excessive information security."(Project manager, distributed project, eight years in company L)*

Company L has highlighted areas for improvement of the knowledge management system in the new setting, especially in terms of improved collaboration. Collaboration tasks have been established in terms of conferencing tasks, knowledge exchange, co-working, and management tasks functionalities. The *conferencing task* consisted mainly of meetings. This was also regarded as the most important collaborative task by Company L, but, due to the increasing level of globalisation of activities, it was becoming very difficult to get people attend a meeting because of busy schedules and the geographical distances involved. Videoconferencing was used in some cases, but the availability of these systems and also the lack of training did not support the extensive use of such systems. In addition, the videoconferencing systems did not seem to be sufficient to support effectively a dispersed meeting. The need for material support was also raised, and this could be achieved with the help of a data conferencing system, which would support the online editing of documents and other files synchronously during a meeting. Data conferencing support could also be used in co-located meetings. The *knowledge exchange task* was also seen as important when considering collaboration. In the software development projects discussed with the company, knowledge exchange was supported almost only with email and Lotus Notes. Both of these functioned poorly because of the lack of knowledge about experts' references and the requirement for immediate answers. In the distributed projects, this is a major problem, and increased effective support for knowledge exchange is needed, since almost all interactions in these projects are made through information technology. The *co-working task* and the *management task* were not raised so often during the interviews. People thought that the knowledge exchange task and conference task were more important than co-working and management tasks. Several reasons were offered: firstly because collaboration seemed to be a prerequisite for effective co-working to occur. Without proper knowledge exchange and the culture of collaborating or conferencing through information technology, working with other people through some technology or other simply did not work out. If people could not act effectively in a dispersed meeting supported by information technology, it was likely that working synchronously through some shared workspace would not succeed. One reason for the lack of a need for co-working support has been indicated by people's attitudes towards co-working. People liked group work to a certain degree, but interviews showed that, for example, designers were not that happy with the idea of working synchronously through some information technology. *Synchronous collaboration* support also had more problems. In distributed projects, and in some cases also in co-located projects, it was hard to find time to use systems collaboratively. People were so busy that it was difficult to have even two people co-working at the same time through some application. Then there are also the time zones differences that influence globally distributed projects, and decrease the attractiveness of synchronous collaboration support, with asynchronous tools being used instead. Therefore, according to the requirements of Company L, synchronous support would more likely be used to support meetings or reviews, and where the focus is more on knowledge exchange rather than collaborative design. The definition of *roles and expertises* was also considered*.* Due to the growing level of globalisation and roles involved in the projects, Company L highlighted the need of formalised lists of experts in order to facilitate their direct involvement. In the previous configuration, the relationships between people and projects/expertises were simpler as competencies were mainly internal. The dispersion, and the involvement of external roles (as suppliers and customers), has created the need to formalise expertises.

Discussion of results, conclusions and propositions

The configurations I.3 and L.1 have been described in Section 7.4 in terms of levers, and have been related to the performances. In this section, the areas for improvement, in terms of these configuration and the innovation strategies of the companies, are discussed. By relating the innovation strategies to the configurations and their performances, some results can be drawn that concern alignment:

- In the case of Company I (configuration I.3), the configuration does not support either the capability to develop new solutions or the transfer of methodologies and issues. The centralised approach only supports, in this case, the efficient retrieval of explicit knowledge about products, but without stimulating sales people to contribute to the development of the knowledge base. On the other hand, if sales people did develop "total solutions" and deal closely with the customer, functionalities related to decentralised approach are used in order to recreate the context of collaboration among people owning knowledge (configuration I.1). In configuration I.3, account managers are strongly stimulated to sell products available through the knowledge base, as their work is then much more efficient. Further, sales overlay do not recognise their role in the business and knowledge processes. There is no longer a possibility to develop customised "total solutions": this task is perceived as time consuming by account managers and not necessary in order to reach the goals set for the sales force. The misalignment between the centralised approach (configuration I.3) implemented in

Company I, and the innovation strategies pursued by the sales unit (especially concerning sales overlay) explains the poor performances (in terms of knowledge process performances, people performances and business performances) of the configuration.

- In the case of Company L, the functionalities of the configuration do not sufficiently support the new requirement to involve external sources of innovation emerging from the newly dispersed context in which the company is operating. More elaborated and formalised functionalities have to be implemented, facilitating communication, collaboration, and identification of experts. In this way, Company L aims to recreate the context that has been lost in the dispersed environment. In order to strongly involve external sources of innovation (suppliers, customers, other dispersed units of the company), Company L decided to invest in the development of the knowledge management configuration, through new functionalities (of ICT, management systems and organisational mechanisms) characterising the decentralised approach.

Focusing on the analysis on Company I, certain characteristics of the *relationship between the knowledge management system and the overall innovation process can* be outlined. As Company I does not consider sales people as a potential source of innovation, the centralised approach is mainly implemented as a system to facilitate the storage and retrieval of knowledge from other units (for example knowledge concerning the product from R&D). Such a system is not designed to acquire knowledge from sales people, who do accumulate knowledge about the customer but as a consequence do not embed it in the KMS. The decentralised approach, as implemented in I.1, on the contrary enhanced communication between dispersed workers operating in the same process phase, or in different phases, of the product innovation process. The flows of knowledge enhanced by the KM configurations can be represented (figure 7.5) using the model of Continuous Product Innovation outlined by Bartezzaghi et al. (1998): the centralised approach (configuration I.3) fosters storage and retrieval of solutions from the R&D unit by downstream phases of PI, or between similar phases in different PI processes (without involving sales people). It is interesting to note that, in this configuration, the source of innovation is the R&D unit, and knowledge stored in the knowledge base is not refined by other units in the PI process. The innovation process is thus still based on a traditional framework (Cooper, 1983). According to the decentralised approach (I.1), knowledge both about solutions and the methodologies adopted is shared, and in some cases generated, by all the actors involved who can potentially be sources of innovation. This is also shown by the feedback flow of knowledge from the downstream phases to the upstream phases of the PI process. Therefore, from the analysis of the relationship between innovation strategies and knowledge management configuration, the role of the considered unit in the overall process of innovation also emerges: the adoption of a decentralised approach facilitates the involvement of all the roles in the process towards contributing to the generation of innovative ideas. On the other hand, such an approach makes it more difficult to create easily retrievable knowledge.

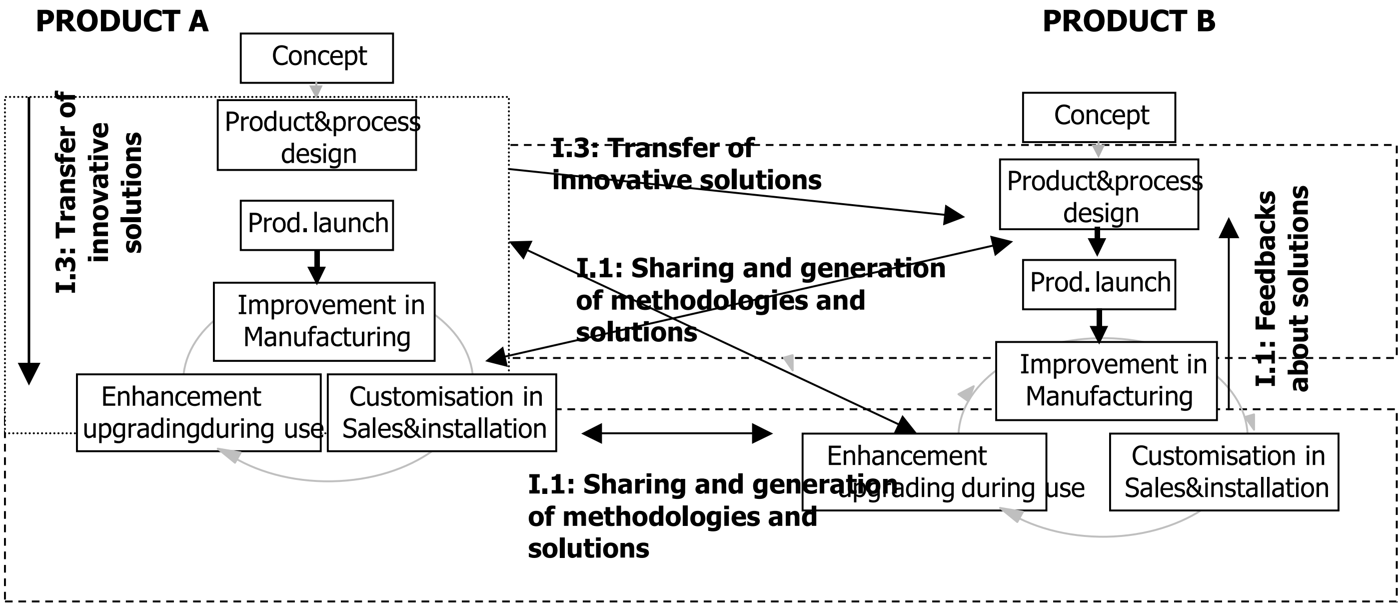


Figure 7.5: The flows of knowledge in PI process fostered by configurations I.1 and I.3

The same observation can be made for Company L, where managers highlighted how the functionalities of the decentralised approach have been improved in order to facilitate the involvement of the downstream phases in the software development process.

From the results of the analysis of Company I and L, a set of propositions can be drawn concerning RQ2. It is interesting to note that propositions P2.7 and P2.8 refine (in terms of alignment) the propositions concerning the association (P2.1.1 and P2.2) identified in Chapter 6.

P2.7 If a company adopts a conservative strategy (exploitation of solutions/methodologies and internal sources of innovation), and the centralised approach supports capitalisation and reuse of knowledge, then it will be successful (in terms of effectiveness of retrieval and efficiency).
P2.8 If a company adopts an exploration strategy (in terms of exploration of solutions/methodologies), then the decentralised approach supporting acquisition, transfer and sharing of knowledge will be successful (in terms of acquisition, transfer and sharing of knowledge, quality of working life and customisation and innovativeness of solutions provided).
P2.9 If a company pursues a strategy based on relevant involvement of external sources of innovation, then the decentralised approach will be effective in terms of generation of solutions, quality of working life and innovativeness of the product.
P2.10 If a company implements a decentralised approach, then every role in the product innovation process is a potential source of innovation.

7.6 THE LONGITUDINAL CASES RESEARCH

In order to address RQ3, the cases of Companies I and L were carried out over time.

Research question

RQ.3 can be phrased as follows: "*How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?*"

To be more specific:

RQ3.1: what changes to the overall knowledge management configuration are stimulated by the change of one of the levers (i.e ICT functionalities)?
RQ3.2 what are the effects of configurational change on performances?
RQ3.3 what barriers to change, and its effectiveness, emerge?
RQ3.4 does the configurational change influence the innovation strategies adopted by a company?
The aim of the longitudinal case studies is to address these questions with explorative goals, in order to provide preliminary theory (and propositions) that can be refined through action research (Chapter 8).

In line with the description of the cases in Companies I and L, the longitudinal analysis will be specifically focused on times T=1 and T=2 (see figure 7.3), while also considering the evolution of the companies from T=0.

Analysis of the cases

As described in Sections 7.4 and 7.5, the two companies, at T=1, have different knowledge management configurations, which need to be enhanced in order to improve the overall performances (knowledge process performances, people and business performances).

Company I

The managers of Company I indicated that the company was successful in terms of gross margin due to sales of (networking) products available on catalogue, but at the same time they saw a low return on sales of "total solutions", poor innovative ideas coming from sales people, and a high turnover in sales overlay staff. Several reasons for these performances have been uncovered:

- *Knowledge activities are perceived as separated from main process activities*. The sales people are the target of the knowledge management tools in Company I. They are rather heterogeneous in terms of competence background (sales management, technology), of focus (sales, technology consultancy, offer building), of product orientation (catalogue products, optical products). On the other hand, the knowledge base, which is extremely large, does not reflect such differences and the search engine is almost ineffective due to inadequate filters. As a consequence, sales people have difficulties in retrieving the right piece of information from the intranet: account managers only retrieve knowledge they are familiar with in order to save time and increase margins. Sales overlay people, on the other hand, do not recognise their role, job and competencies in the structure of the knowledge base due to the different language, organisation and culture. Moreover, the knowledge base does not reflect the peculiar organisation of the sales people in the new business unit (Section 7.4)

- *Misalignment between new knowledge management configuration and innovation strategies*. As discussed in Section 7.5, people in the selling unit of the Italian company, before the acquisition (configuration I.1), were used to being involved in the PI process with a relevant role in innovation. Through the implementation of the new knowledge management system, which mainly concerns knowledge about products available on catalogue, and their new role as "consultants" to new account managers on optical products, they no longer recognise their contribution in the innovation process, since account managers are fostered in reusing solutions available on the Intranet which are easier and faster to retrieve.
- Moreover, in Company I *barriers concerning a lack of familiarity with web tools* have not been recognised. People show a lack of time and low familiarity with web tools: unlike in the U.S. headquarters, Latin people are more used to personal and verbal communication rather than web usage (Hofstede, 1980; Corso et al.1998).

In order to improve the situation, two possible suggestions have been discussed with managers, each requiring with a different level of innovation in the knowledge management system:

1) The *light impact scenario* aimed at improving a) the structure of the knowledge base in order to include knowledge about selling methodologies and not-standardised products; and b) the transfer functionalities*.* The basic assumption is that facilitating the access to really useful knowledge would stimulate all the roles involved in selling activities (especially sales overlay) in knowledge retrieval and reuse. This could be achieved through redefining the content hierarchy, creating summaries of relevant knowledge, improving the search engine filters, highlighting order winning proposals and case archives directly created by the sales force, standardised presentations, improving the availability of product configurations, pricing tools, and multilevel technical documentation, and the possibility of creating personal web pages. These are all interventions that act on the structure of the knowledge base, trying to adapt it to the goals and structure of the new organisation and values.
2) The second option is the *heavy impact scenario,* which requires the adoption of a completely different configuration for knowledge management: the creation of a virtual community of sales people (Brown and Duguid, 1991; Wenger and Snyder, 2000). The concept of a virtual community refers to the use of intranet ICT technologies to link together otherwise dispersed individuals through various forms of computer-mediated-communication. Moving to this approach, for Company I would mean facilitating communication and collaboration among individuals through fostering knowledge exchange (a decentralised approach). Even though these tools are already available in

Company I, as they are part of the Web instruments of everyday work, the community does not currently exist because there is no social awareness of it. The main intervention, therefore, requires not only a technological investment, but also a cultural one in order to create an awareness of the community. Two main changes have to be taken into account if this scenario is implemented, especially in terms of communications rules: firstly, *frontiers between interpersonal and public communication fall* (Brown and Duguid, 1991): in a virtual community, given its nature of spontaneous aggregation of people interested in the same issues, when information is requested and as a consequence supplied, it instantly becomes "*public*", in the sense that it is available to all the members (horizontal decentralisation); for this reason if the information is well reputed by the community it receives a sort of legitimacy. Secondly, *changes in people involved and in info flow control.* (McDermott, 1999): currently the communication between managers and the sales force is one way with a strict control over information; consequently there is no way for sales people to verify its accuracy or to complain about its lack of completeness (vertical decentralisation).

Due to the consolidation of the knowledge base of Company I, its values, the huge cultural change required to implement the second choice, and especially the size of the acquired company compared with the overall dimensions of Company I, the managers favoured the light impact scenario: that is improving the functionalities of the current approach, without changing the overall knowledge management configuration.

Mapping the configuration at T=2, several changes in the configuration (I.4) have been assessed in order to reach performances:

- Company I had to improve the familiarity of sales people with the Intranet. As managers realised that especially sales overlay staff did not recognise the Intranet as a valid tool for their work, they started two lines of intervention: firstly, the organisation of several training courses in order to facilitate the use of web-based tools, and, secondly, to make the use of the Intranet necessary to perform everyday work. All procedures, modules and prompts essential to carry out one's job, started to become available only through the web.
- Incentives for knowledge provided on the Intranet. In the previous configuration, knowledge could be published only centrally; some preliminary trails have been made, permitting people, if allowed by their bosses, to publish useful knowledge about their activities. This can be recognised and rewarded by the bosses.
- This possibility to provide knowledge on the Intranet has been a good incentive also for sales overlay staff, who can now recognise their contribution to the knowledge base and to the selling process itself.
- The possibility of personalising the access to the knowledge base has made people more aware of their role in both knowledge and business processes. This had several effects: the retrieval of useful knowledge for carrying out the job, the identification of similar roles in other settings of the company, and therefore a better integration of people within the overall organisation of the company itself. Moreover, it has facilitated the retrieval of useful knowledge for sales overlay, from other optical companies in the group.

- Recognition of the expertise of sales overlay within the organisation, in terms of the development of innovative solutions for customers. As the sales overlay staff has started to recognise their role in performing business activities and in contributing to the knowledge base, the company has enhanced the integration between them and account managers. Specifically, sales overlay has started to contribute to the knowledge base by providing knowledge concerning development of "total solutions", and at the same time they are retrieving from the Intranet practices and experiences from other subsidiaries of Company I focused on optical products. They have acquired reference roles for account managers in addressing customers requiring customised and highly innovative products. Managers pointed out that, sometimes, sales overlay carried out the preliminary activities of developing solutions with customers in order to develop an offer together with account managers.

Company L

In Company L, the situation at T=1 is characterised by people having great difficulties in carrying out knowledge processes and business process (software development), due to the high level of globalisation of activities and high dispersion of competencies. More specifically:

- *People were aware of the importance of past experiences to develop new solutions*. For example, the use of the product platforms consolidated this awareness. Managers of Company L, pointed out how the *Not Invented here syndrome* could be a strong barrier to change, although it was not the case with R&D people in the company. Nevertheless, the difficulties in accessing knowledge for technical and cultural issues were a barrier to the flow. Technological reasons were mainly related to the traditional means available (Lotus Notes, email and phone), cultural reasons were related to the difficulty of project managers identifying their tacit knowledge and sharing it.
- *People were used to teamwork*. Team working is a consolidated practice in Company L since concurrent engineering is carried out. Nevertheless, if the team was dispersed there were major difficulties in performing these practices.
- *The typology of knowledge managed* in the considered subprocesses of Company L. The unit of analysis is related to R&D, where knowledge is innovative and often not consolidated (especially in a concurrent engineering setting). The KM system has therefore to deal with tacit, not always consolidated and formalised knowledge, which is often continuously revised within the PI process (especially related with the nature of the product which is software).

Company L decided to improve the knowledge management system through implementing new ICT functionalities, which characterise the configuration mapped in T=2 (configuration L.2), as follows: 1) *Information updating and notification of availability*. An up-to-date version of the material should always be available to each person. Either certain information should automatically be provided to people based on profiles, or notification of availability should be provided. 2) *Searching and inviting people:* based on profiles, experts should be contacted for meetings through different devices and confirmation or denial is provided within short time. 3) *Knowledge retrieval*: people should be able to assimilate relevant information both from the internal network and from external sources. 4) *Asynchronous knowledge transfer*: working material should be transferred to interested people on time with high reliability, regardless of the position of the user within the network. Support should be given to focus users' attention on relevant changes.5) *Synchronous one-way information transfer*: people should be facilitated in transferring documents and information in real time. People should be able to access experts and to have a real time communication with them. 6) *Synchronous communication in a community*: people should be able to interact in a global community through a rich communication media, saving the time and cost required for face-to-face meetings (group-wise communication). 7) *Synchronous collaboration on artefacts:* participants in a community should be able to collaborate in real time on artefacts through different media (documents-centred collaboration). 8) *Community establishment and updating***:** a community should be established with the available experts and the people involved, including information on specific competency profiles and how to contact them. It should be continuously updated.

In order to perform some of the functionalities of ICT (searching and inviting people, knowledge retrieval, community establishment and updating), Company L defined experts. In the previous configuration, experts were contacted, but they played an informal role within the organisation. Now the company developed a map of the profile of expertise, according to the different phases of product development and each product platform. Experts are recognised within the company, and the work team addresses them in order to solve specific problems.

Functionalities have been implemented in the target processes and several results have been obtained:

- Reduction of costs related to travel and subsistence (about 30% in the first year), as most of collaborative work is performed through the web.
- The identification of specific competencies of people, and their involvement in reviews as experts. During the reviews, one relevant activity has been identified as "expert search and inviting". This activity has been facilitated by building up a list of experts and their association with specific expertise. This had a double effect: from the process point of view, it was more efficient to involve experts in reviews, as they are automatically invited; from the experts' point of view, this is a very good incentive for building up an expertise, as one's visibility within the organisation becomes extremely high.
- Contribution to building a community. A community is a group of people informally bound together by shared expertise and passion for a joint enterprise (Wenger and Snyder, 2000). The functionalities of the technology allow the recreation of the *context* for communication and shared working which is missing in dispersed environments. Nevertheless, to create and nurture the community, ICT infrastructure alone is not enough. In literature, several elements have been highlighted: the design of the relationship with the organisation (McDermott, 1999; Brown and Duguid, 1999; Wender and Snyder, 2000), the composition of the community (Magnusson and Davidsson, 2001), the ways and language to organise knowledge (McDermott, 1999), the relationship between the learning and operative work of communities (Brown and Duguid, 1991). All these issues are still unexplored in Company L. Technology has been established in Company L, as a means of facilitating the creation of a community of people in terms of sharing knowledge among dispersed workers having common interests and specific competencies and expertises. However, the evolution of the community has not been explored due to the timing of the case study.

Discussion of results, conclusions and propositions

The results concerning the analysis of the different configurations are outlined in figure 7.6. The focus of the analysis is on configurations I.3 and I.4, and L.1 and L.2. In order to develop a complete picture of the evolution of the configurations (especially for company I) I.1 and I.2 are also represented.

Configurations	*Functionalities of levers*	*Configuration*	*Barriers*	*Performances*	*Innovation strategies of the unit*
Configuration I.1: Italian company before acquisition	Communication (phone, fax or email) Diffused responsibility	Decentralised approach		Frequent transfer and sharing (B4 and B5), generation (B2 and B3). High satisfaction in work and loyalty of the customer	Development of "total solution" Strong source of innovation in the PI process
Configuration I.2: Company I before acquisition	Storage and retrieval through Internet and Intranet services. Huge knowledge base Rewarding systems on business activities results Standardisation	Centralised approach		Frequent generalisation (B6) and embedment into vehicles (B7) High turnover and gross margin	Low level of innovation related to activities of sales people
Configuration I.3: Company I after acquisition	Storage and retrieval Reward systems on business activities results Standardisation	Centralised approach	Low familiarity with web tools Separation between knowledge and business process	Poor generalisation (B6) and embedment into vehicles (B7). More frequent transfer and sharing (B4 and B5). Low loyalty of the customer	Sales overlay is still focused on development of "total solutions"
Configuration I.4 Company I after implementation of new ICT	Storage and retrieval: possibility of contributing to knowledge base; training, focus on Intranet as a working tool, personalisation of interface. Recognition of expertise for sales overlay in development of total solutions.	Centralised approach: low horizontal decentralisation, medium vertical decentralisation, coordination mechanisms based on standardisation	Low familiarity with web tools Recognition of roles Lack of power in providing knowledge	Improvement of: Generalisation (B6) Transfer among processes (B5) Embedment into vehicles (B7) Generation of knowledge (B2 and B3). Higher loyalty of customer, Better work satisfaction Higher turnover at the beginning	Development of an integrated sales force able to: sell standardised products and innovative "total solutions" in short time and good costs.
Configuration L.1: Company L	Communication and collaboration, Plan for knowledge transfer,CE, platforms, Diffused responsibility	Decentralised approach		Frequent transfer and sharing (B4) and generation (B2 and B3). To be improved B5 and all the others.	Exploration of new solutions. Mainly internal sources of innovation
Configuration L.2: company L after implementation of new ICT	Communication and collaboration through more powerful tools embedded also in business practices, identification of experts, community development	Decentralised approach	Not Invented here syndrome Difficulties in carrying out teamworking Type of knowledge	Frequent transfer and sharing (B4) and generation (B2 and B3). Frequent transfer among processes (B5) and assimilation from external sources (B8). High quality of working life Lower travel costs	Exploration of new solutions. Involvement of external sources

Figure 7.6: Configurational changes and their effects in Companies I and L

Certain observations emerge from these results that will be useful in developing the action research approach:

- Firstly, in the two cases studies, the configurations have been changed through the implementation of new ICT functionalities. In both cases (I.3 and L.1), the companies have chosen to start from ICT in order to improve performances of the knowledge management configurations. Nevertheless, in both cases, changes in the other levers also occurred: in Company I, in terms of training, and the definition of roles in knowledge and business processes in order to facilitate the standardisation of work processes and output. In Company L, changes have been seen in the definition of roles according to expertise, and in community development in order to foster mutual adjustment and skill standardisation. Overall, the functionalities of levers reflect the characteristics of configurations highlighted in Chapter 5, realising a centralised approach (I.4) and a decentralised approach (L.2).

- The configurational change and the solutions implemented are mainly aimed, in both companies, at enhancing the adoption of innovation strategies. As described in Section 7.5, at T=1 neither configuration is aligned with the new innovation strategies (driven by external factors) of the companies. Especially for Company I, the adoption of configuration I.4 facilitates the integration in the organisation of sales overlay, who have started to recognise the value of the Intranet in better performing their activities. They have started to combine knowledge from the knowledge base with their own tacit knowledge in order to provide solutions to the customers, and at the same time can contribute to improving the knowledge base. The managers, moreover, have recognised a higher level of standardisation in the solutions developed, due to the common knowledge base now being used in all the subsidiaries of Company I.
- Barriers to change have emerged from discussions with managers. Some of them are directly related to the people involved in the new KM system: their familiarity with web tools, not invented here syndrome, lack of power in providing knowledge. Others are related to previous practices of the considered unit, such as lack of team working and preference for keeping knowledge in tacit form. These barriers have been identified by the managers and have been managed in order to enhance the effectiveness of the KMS on performances. However, the list is not exhaustive and it is related only to a specific setting.
- The relationship between the operational and knowledge processes. Firstly, it seems that companies try to limit their investment related to configurational change, and therefore choose to implement levers which have also direct effects on operational processes. Moreover, the stress on operational processes resulted, in both the case studies (I.3 and L.1), as a constraint on knowledge processes especially in terms of time priorities and combination of activities. At the same time, both companies used the focus of people on operational process goals to facilitate the adoption of knowledge management system (I.4 and L.2): Company I transferred all the documents and prompts for carrying out sales activities to the Intranet in order to overcome the low familiarity to web tools by sales people. Similarly, Company L implemented new ICT functionalities (especially collaboration and communication) that were useful in enhancing both knowledge and operational processes.
- The choice of which ICT functionality to implement was made by the two companies after considering the effects of the new configuration on the overall organisation. Although the change is designed only within the functional unit, the effects of the knowledge management system can influence the overall organisation. For example, the role of the functional unit within the overall product innovation process can change since it can be recognised by the organisation as a possible

source of innovation. This observation leads to a new research question, aimed at investigating whether the knowledge management configuration adopted in a functional unit can foster the adoption of innovation strategies (Chapter 8).

The results in terms of RQ3 lead to the following propositions, which will be refined through the action research process (Chapter 8):

P3.1 If ICT functionalities are changed within the configuration; the other levers also change in order to support the overall configuration.
P3.2 If barriers to change such as culture, values, attitudes of people, and lack of familiarity with technology arise; the knowledge management configuration is not effective in terms of learning behaviours.
P3.3 Consolidated practices in the company are a barrier to change. If the new functionalities of implemented levers require a change in consolidated practices, and no specific lever addresses this barrier, the configuration is not effective in terms of learning behaviours.
P3.4 If the knowledge management configuration does not explicitly stimulate people to carry out knowledge processes, the stress on operational process goals and lack of available slack will reduce the effectiveness of the configuration on learning behaviours.
P3.5 If the stress on operational process goals is very strong, and the knowledge management configuration uses the same levers to carry out both knowledge and operational processes, then the decentralised approach will be effective in terms of knowledge workers seeing their activities as opportunities to develop knowledge (B2) and in the use of spare time to generate knowledge (B3).
P3.6 The adoption of a knowledge management configuration fosters a refocus of the innovation strategies

7.7 SUMMARY

The main goals of Chapter 7 have been to refine the theory that came from the explorative analysis in consultancy companies, and to develop preliminary insights about configurational change that will be further developed in Chapter 8. The chapter has been organised according to the research questions to be addressed. In more detail:

- The cases studies enabled the knowledge management configurations emerging in consultancy companies, to be explored in other professional knowledge-intensive organisations. The same configurations emerged in the new research sample, with the same detected effects on performances. Moreover, additional peculiarities in the new sample (in terms of product and consolidation of knowledge practices), and a focus on a functional unit, allowed new propositions to be developed.
- In Chapter 6, the association between innovation strategies and knowledge management configurations was analysed for successful consultancy companies. The two cases described in this chapter enabled the verification of the low-level performances in the event of non-association.

- The case studies have used a longitudinal approach. This allowed the variables in the process to be analysed at several moments in time. The most significant result is the fact that, within a configuration, if one lever changes (specifically ICT), the other levers also change. Moreover, in the considered cases, the barriers are not the inverse of levers: specific barriers hinder the effectiveness of levers on behaviours. However, more research needs to be carried out in order to address which levers can be implemented in order to overcome which barriers and the related effects on performances. Finally, the propositions arising from the case studies are rather general: they require further investigations in terms of cause-effect relationships (effects on specific performances and role of levers in overcoming the specific barriers allowing the KM configuration to be effective in terms of behaviours) and refinement of the meaning of the variables. These issues justify the use of the action research approach (see Chapter 8).

CHAPTER EIGHT: THE ANALYSIS OF CONFIGURATIONAL CHANGE

8.1 INTRODUCTION

The chapter addresses the third research question:

How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?

RQ3.1: what changes to the overall knowledge management configuration are stimulated by the change of one of the levers (i.e. ICT functionalities)?

RQ3.2 what are the effects of configurational change on performances?

RQ3.3 what barriers to change and its effectiveness emerge?

RQ3.4 does the configurational change influence the innovation strategies adopted by a company?

The research question has been already partly addressed through longitudinal cases which produced results related to:

- The overall configurational change due to the change in one of the levers (specifically ICT)
- The existence of barriers to change related to the actors involved, to the coherence with organisational, managerial, and technological choices of the company, and to coherence with operational processes.

In the previous chapter, propositions were developed through explorative research, providing the basis for action research. In this chapter, Section 8.2 describes the methodology, highlighting the reasons for the adoption of a participative approach; Section 8.3 addresses the development of the action research case, in terms of characteristics and role of the researcher. Section 8.4 describes the evolution of the case over time, and Section 8.5 discusses the results.

8.2 THE ACTION RESEARCH METHODOLOGY

Literature about action research is extremely complex, and approaches the issue from several perspectives (Reason, 1998; Argyris, 1997; Adler and Shani, 2000). The approaches that have emerged in the past fifty years include: participatory inquiry, action science, clinical field research, developmental action inquiry, appreciative inquiry and action research. It is beyond the scope of this thesis to go through all these approaches, nevertheless it is useful to explain which principles are common to these approaches, and the methodology adopted in this research.

At the most basic level, all the types of participatory inquiry aim to develop "actionable knowledge" and, at the same time, they deal with the challenge of developing valid, generalisable knowledge.

Starting from Habermans' classification (1981), human or "cognitive interests" can be classified as a) technical control; b) mutual understanding/practical interest, or c) emancipatory interest. Technical control aims to develop knowledge that expands the power of technical control as it aims to manipulate and control of the environment, both natural and social. Mutual understanding (or practical interest) aims to develop knowledge and interpretations that makes it possible to orientate action within common tradition through the understanding of meaning in a specific situation in order to make a decision and take an action. Finally, the emancipatory approach aims to generate knowledge that furthers human autonomy and responsibility.

Cognitive interests **Action research streams**	**Technical control**	**Practical interest**	**Emancipatory interest**
Participatory inquiry (Reason, 1998)	To a limited extent	To a moderate extent	To a major extent
Action science (Argyris, 1997)	To a limited extent	To a major extent	To a major extent
Clinical field research (Schein, 1987)	To a moderate extent	To a limited extent	To a major extent
Developmental action inquiry (Torbert, 1990)	To a limited extent	To a moderate extent	To a major extent
Appreciative inquiry (Cooperrider, 1996)	To a limited extent	To a moderate extent	To a major extent
Table tennis research (Adler, Shani, 2000)	To a major extent	To a major extent	To a major extent

Figure 8.1: The main action research streams (from Adler and Shani, 2000, p.5)

Figure 8.1 reflects major contributions to the theory on action research. According to Adler and Shani (2000), what distinguishes action research from other inquiry collaborative approaches is that only action research has the potential to pursue all three interests simultaneously.

All the perspectives listed, address emancipatory interest to a major extent, and this is mainly related to the possibility of developing a collaborative form of inquiry (Heron and Reason, 1997), and therefore is also related to a participative worldview (Torbert, 1990; Reason, 1998; Cooperrider, 1996; Argyris, 1997). These collaborative forms of inquiry are related to two main participatory issues: *epistemic participation* and *political participation*, which distinguish these approaches from the traditional qualitative and quantitative research. Epistemic participation means that any propositional knowledge that is the outcome of the research is grounded by the researchers in their own experiential[1] knowledge. The second principle means that the research subjects have a basic right to participate fully in designing the research that intents to gather knowledge about them. From the first principle, it follows that the researchers are also the subjects of the research; from the second principle that the subjects are also the researchers.

These two principles sustain a strong emancipatory interest and, to a moderate extent, a mutual understanding interest.

Despite this, most of the collaborative forms of inquiry only support a technical control approach to a limited extent. Only clinical research, unlike the other participative inquiry approaches, supports to a moderate extent the technical control interest. In their reflecting and researching, clinicians perform therapeutic acts and generate all their data in the everyday course of being a therapist. They reflect on performance events in a "thinking out loud" manner and form a critique of the particulars of the interplay between therapist and client. This collaborative problem-solving partnership, between the practitioner and the practice, results in therapists weighing and considering actions taken, or not taken, and making adjustments and preparations

[1] Experiential knowledge is gained through direct face-to-face encounter with person, place or thing; it is knowing through empathy and resonance, and is almost impossible to put into words (Reason, 1998)

for their next performance in the clinic. These researching therapists may also take on a more scientific posture, and conduct more formal and systematic studies of their therapeutic practice by recording and re-viewing their sessions. Observations of these sessions may be written up and even published as clinical pieces. Technical control can be therefore related to the *possibility of abstracting from experiential knowing and through that generating theory* (Adler, Shani, 2000). A similar approach is used in "Table tennis research", which addresses all three human interests to a major extent. It is driven by intermediate theories created and developed in continuous "Jam sessions" which are an intermediate between action and reflection. The word "intermediate" reflects both the time, as developed during the process, and the level of abstraction. They are not general theories but more applicable, and through the application they are continuously changed and refined. The basic assumption underpinning table tennis research is that "testing intermediate theories in action is the best way to validate them, and that organisational actors are essential in analysing and validating the findings (Adler and Shani, 2000).

Starting from the main characteristics of participative research, and in particular table tennis research, a framework for the methodology adopted in this thesis is operationalised as shown in figure 8.2. From more recent contributions that address the issue of developing theory through an action research approach (Coughlan and Coghlan, 2002; Adler and Shani, 2000), a model for the analysis of the case was developed (see figure 8.2). In the model, two levels of analysis are distinguished, which correspond to different roles performed by the researcher. In the first layer, the researcher is part of the team acting in the company and driving the analysis, application, and refinement of the model together with practitioners. In the second layer, the researcher conceptualises the first layer activities as well as the interaction with and among the practitioners in a sort of double loop learning (as noted in Argyris, 1997). Other characteristics of the model include:

- Performance of the process takes place in real time and with real issues. The commitment of the company is extremely important, as time and resources have to be dedicated and experimentation is encouraged (Adler and Shani, 2000).
- The research team consists of both practitioners and traditional researchers from different disciplines (Adler and Shani, 2000; Reason, 1995).
- The action research takes place in the natural work setting (Torbert, 1990; Reason, 1995; Cooperrider, 1996; Argyris, 1997).
- The action research needs to manage political dynamics (Heron and Reason, 1997; Adler and Shani, 2000).

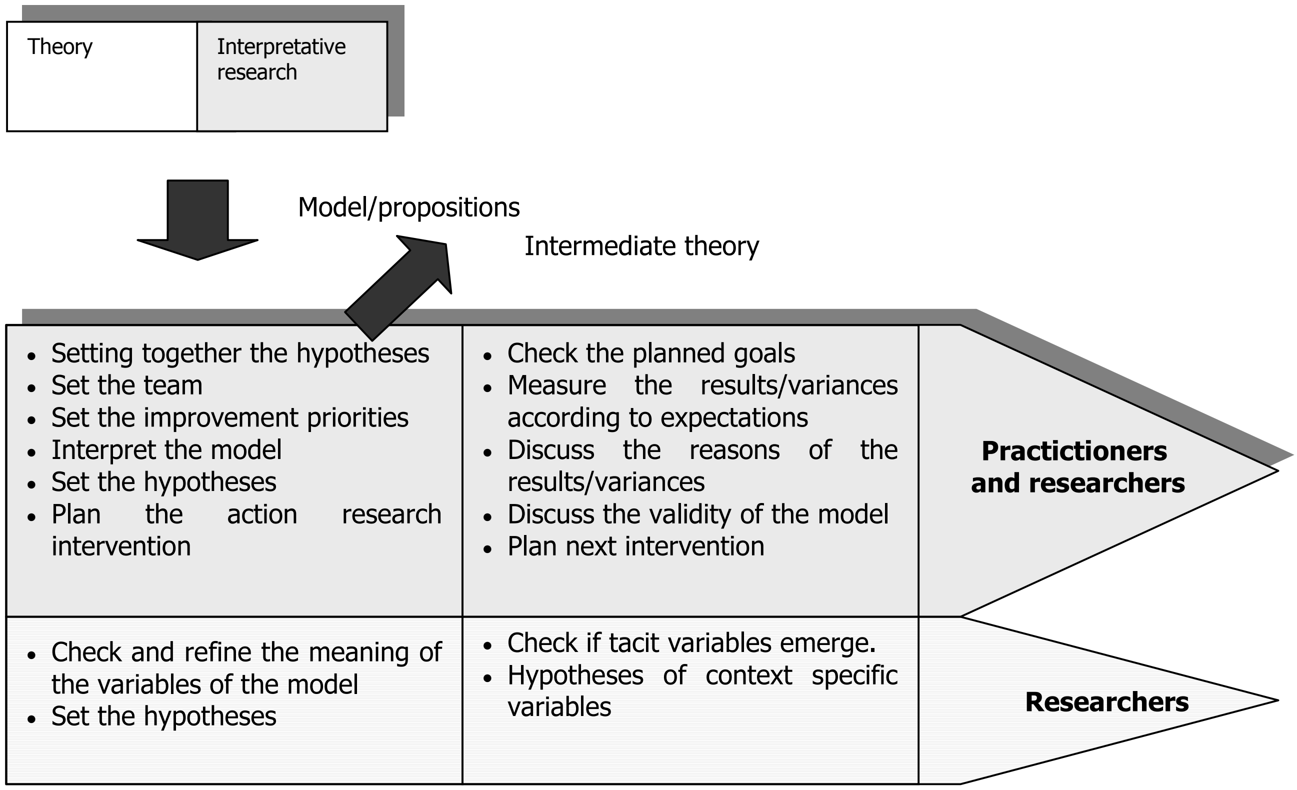


Figure 8.2: The action research approach operationalised in this thesis

- The very important issue is the development of intermediate theory. The action research process is made up of continuous plan-do-check-act loops at the two levels. The actionable knowledge developed at each stage is intermediate theory, whose quality strongly depends on how the overall action research process is planned and carried out
- In order to enhance the plan-do-check-act loop at each stage it is particularly important to build up a system of performance indicators.

In this thesis, several characteristics of the research have led to the adoption of a participative approach: the research *objective*, the *complexity* of the topic (in terms of number of variables and their changes over time), and the overall *structure* of the research (based on explorative research and then action research to refine propositions). After the development of the longitudinal cases, two other reasons evolved that appeared to be relevant in the adoption of a participative research:

- *The need to check and refine the meaning of variables in the model of knowledge management.* As emerged in Chapter 7, in some stages of the longitudinal cases studies, managers were involved in the analysis, by conducting interviews within the company. This was very useful for the research, both because it was easier for managers to approach employees, but especially because some feedback on the variables in the model, the phrasing, and the meaning of relationships among them came from the managers.
- *The need to continuously check the evolution of the system understanding the cause-effect relationships.* From the longitudinal case studies, several interpretations of the evolutions of the system could be made. However, it was not possible to determine the cause-effect relationships, as

it is not always clear which was the independent variable. In the action research, the possibility of researchers suggesting several changes to the system (based on their hypotheses), allows them to monitor the effects, and therefore identify the actual cause-effect relationships.

Through the adoption of the action research approach, the analysis of configurational change will be carried out in this chapter. Section 8.3 provides a description of the case, and also describes how the action research process has been carried out. In Section 8.4, the configurational change will be described in terms of evolution of configuration of levers according to the implementation of new ICT functionalities. This starts from propositions arising from previous stages of the research, jointly discussed and agreed with company managers. In Section 8.5, results concerning the configurational change will be discussed in terms of:

- The evolution of the internal configuration of levers
- The type of knowledge managed
- The development of the community
- The evolution of the knowledge performance
- The alignment with the innovation strategy
- The barriers to configurational change and to its effectiveness

These issues are directly related to the subquestions of RQ3.

8.3 THE DEVELOPMENT OF THE CASE OF COMPANY K

This section aims at describing the action research case, in terms of characteristics of the company and its goals (Introduction and goals), in terms of the knowledge management system implemented (The description of the functionalities of the portal), in terms of achieved results (The results), in terms of the process followed in carrying out the research (The action research process).

Introduction and goals

The company where the study was developed (referred to as "company K") is a leading telecommunications service provider (mobile phone services) in Italy. Formerly with a market monopoly, the company has had to cope in the recent years with an increasing number of competitors.

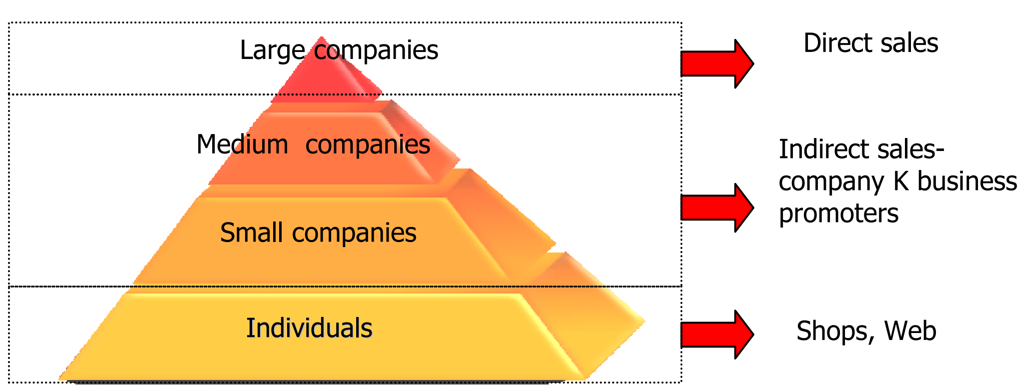


Figure 8.3: Company K business sales organisation

The action research case is focused on company K's indirect sales network for servicing SMEs. In practice, company K's business sales network is structured according to customer size as depicted in figure 8.3.

As depicted in figure 8.3, large companies are usually approached directly, through specific account managers. Individuals (i.e. consumers), at the opposite end of the scale, are approached through standard retail channels such as shops or web selling. To address the specific needs of SMEs, company K has established a specific indirect sales network, consisting of more than 150 agencies (referred to as company K business promoters-or TBP) and 1000 agents. This SME business is very important for company K, with a yearly turnover of more than €1000 million.

The context reflects a high level of complexity: on one side, the economic relevance of the business is very high and presents high potential growth; but on the other side the sales network is difficult to manage with a large number of agents that company K cannot directly control as they are employed by entrepreneurs.

At the same time, in 2000, the strategic priorities were very clear, and very much related to the performances of the salespeople, namely:

1. To consolidate and maintain Company K's market share (60% in the business)
2. To improve the quality of sales. One of the Company K's strategic objectives is to move sales from "voice services" to "complex services sales". This requires new competences of salespeople who have to improve their understanding of the services (from technical, commercial and regulation points of view) and of customer needs and structure.
3. To face increasing market churn. As the number of competitors is increasing, company K's sale network has to improve customer loyalty through providing better service. The actual level of Italian market churn in this field is 18%, compared with an European average of 30% (Pellegrini, 2001).
4. To reduce the high turnover in sales personnel. If the previous points have stressed the importance of building new competences in the sales people, and investing in them in order to improve customer loyalty, high labour turnover (50% every year) is the really critical issue. The agents are directly employed by the TBPs, who manage their activities through short-term goals (mainly sales targets).

So, in line with these critical points, Company K set three objectives, which have driven the design and implementation of the knowledge management system. The company assumed that, through the management of the salespersons' knowledge, the following goals could be reached.

1. Reduction in the turnover of agents in order to increase the stability of the relationships with company K customers.
2. Direct interaction with company K's sales force in order to facilitate the fast and complete update of agent's competencies.
3. Continuing the process of growth in order to improve the level of satisfaction of agents in their relationship with company K.

In particular, goals 1 and 2 are related to the strategic goals of Company K: the company aims to improve the competencies of the salespeople in order to provide "complex services sales", which are customised and innovative according to the characteristics and requirements of the customer. The strategic priorities of Company K reflect a high level of innovation in the solution provided (exploration strategy) due partly to the contribution of salespeople in the customisation phase. Moreover, due to the relevant role of the customer in the sales process, an aim of the company is to facilitate the integration of external sources of innovation.

In order to reach such objectives, the company has decided to implement, together with their consultants (referred to as "Company Z" from now on), a community that facilitates sales people in exchanging knowledge about products, services, market, and competitors though a portal.

Two main of types of constraints have emerged since the beginning of the development: contextual and personality factors. The former concerns the organisation of the sales force of Company K: the number of customers, their size (SME with low technical competences), no specific area allocation to salespeople, and their contractual position (they are employed by TBP centres). These elements contribute to creating a strong competition among the salespeople, them having a poor alignment with Company K's goals, and providing few levers for the departments of Company K to manage them directly. This was strengthened by the fact that, at the beginning of the project, it was not clear who was or had to be the real sponsor of the project: the HR department, the marketing department, or the sales department. The personality factors, on the other hand, reflect the behaviours of salespeople. It is interesting to note that one main element characterises their approach towards work: the need to be the first. Salespeople are strongly committed to be the best, and to be more visible and competitive. As a result, they are only interested in information, procedures, and practices that help them come out on top.

In approaching the case, it is useful to identify the competences that Company K wants to develop in the salespeople. The director responsible for sales in company K stated that salespeople should be engaged in:

1. Selling activities: in terms of looking for new potential customers, the study of their needs, and the negotiation of selling proposals and contracts.
2. Activities providing services to customers: for instance, promotional help, after sales service, and service in the utilisation phase. Linked to this activity, an important competence, which is strongly related to quality of the service offered, is the capability of providing customers with detailed information about the precise content of the service offered through a comprehensive and clear language fitting the characteristics and preparation level of each customer.
3. Activities related to transferring information to the company: in terms of evolution of market needs, competitors' activities, and the correspondence of offered products to customer requirements. This information has a very strong potential benefit for several company departments including, marketing, R&D, and operations.

In order to perform such activities, Company K aims to develop the following competences in its salespeople:

- *Technical capabilities*: salespeople have to precisely know the characteristics of the services offered and how they differ from those of the competitors. Salespeople are not specialists but they should be confident with the product/service and of explaining it in a clear way.
- *Problem solving capabilities*: salespeople operating in the business area have to approach the specific requirements of companies, and understand how to solve their problem though a Company

K solution. Such capabilities include knowledge about specific applications of the service provided and its impact on a company's processes.

- *Customer approaching capabilities*: salespeople should approach a customer already knowing its history. The customers are mostly SMEs, which are very business-oriented, and need a solution for their precise problems. A knowledge base enabling retrieval of past experiences with each customer is essential in order to save time and focus the relationship with the customer.
- *Abstraction capabilities*: potential information about the future evolution of the market and development of new products/services can be obtained through approaching several customers. However, developing knowledge about market evolution from the interaction with specific customers requires a process of abstraction. Abstraction requires increasing the information about all the customers (and so interacting with other salespeople), analysis of information, sensibility to weak signals, and understanding the use of such information to people within the company.
- *Integrating with company K capabilities*: this issue is critical as will be shown in the analysis of the case since salespeople are not employees of Company K, but of TBPs. So, in order to facilitate feedback to Company K, it is important to align the goals of the sales people (or TBP) to those of Company K, build a clear understanding of Company K processes and of the role and contribution of salespeople in them, and which are the units/people to whom they should refer.

The description of the functionalities of the portal

The knowledge management configuration has been developed by starting with the implementation of new ICT functionalities, referring to a portal supporting a community of salespeople (see figure 8.4). In this subsection, the characteristics of these functionalities will be described in order to address, in the following section, the characteristics and the evolution of the overall configuration.

The characteristics of the portal developed by Companies K and Z, as it stood after about one year (February 2002), are built around three main integrated functionalities: informative functionality, training functionality and social functionality.

In order to perform such functionalities, the portal is organised in five channels as depicted in figure 8.4: news, training, offer, desktop and community.

In the ***news channel*** Company Z reports everyday on the most useful and interesting news. Some examples concern Company K and its competitors commercial and patrimonial situation, joint ventures and acquisitions, information about technological innovations with mobile telephones and relative services (TechNews), information about the consumer business in Company K, curiosities and peculiar or specific papers which can be used by salespeople in order to stimulate the discussion with a customer or colleagues. All the information is available through the portal: either directly on video, or through a search engine operating on date or keywords.

The ***training channel*** provides training courses to develop selling skills and competences. These courses are accessible though the web (e-learning) and are certified by Cepas (Italian certification company for sales). Such certification is important for the salespeople as it is recognised by the EU (norm EN 45013) and represents an asset they can build over time. Cepas certifies the professional capability in performing selling activities, producing a "service for the customer", and therefore creating value for the customer itself.

Some examples of training courses organised by Company Z, and accessible though the portal, are:

- Courses of selling practices and communication, dealing with issues such as relationships with the customer, the phases of the selling process, the selling of services.
- Specific courses about Company K services, aimed at developing confidence with new applications of mobile telephones and Wireless products.
- Courses concerning the Internet and the New Economy.

The ***offer channel*** collects information concerning Company K products and services and those of its competitors. Initially, this channel did not exist and the information was included in the desktop channel. However, by monitoring the questions coming from salespeople, Company Z realised that the amount of information concerning the products and services, and the competitors, was such that it justified the creation of a separate channel. This decision also had positive effects on access to the information, especially during discussions with the customer.

Figure 8.4: The structure of the portal

The ***desktop channel*** includes:

- Agenda: an updated calendar of events and fairs of interest for salespeople.
- Useful tools: a dynamic collection of tools, presentation and ideas to better manage the work of salespeople (such as planning tools, notes…)
- The expert: it is a support service concerning commercial and fiscal issues that Company Z offers to members of e-volution community.

The ***community channel*** is a space that provides an opportunity for members of the portal to get to better know each other, and discuss and analyse common experiences and perspectives. Through this channel it is possible to ask questions and communicate experiences though discussion forums. So far, the following forums are available on the portal:

- Extension: a specific forum dedicated to Extension, the new Company K service. Here, it is possible to discuss doubts and offer possible solutions.
- On the market: this forum is dedicated to different elements related to the work of agents. Particular attention is paid to subjects concerning products and services, customers, applications and competitors. From here, relevant information concerning trends and customer needs can be derived and forwarded to Company K's marketing departments.
- Coffee break: a free forum where it is possible to discuss common interests beyond the job of being a salesperson;
- Bacheca: a forum where it is possible to see and discuss other colleague's offers in a sort of virtual market.

All the forums on the portal are moderated by a tutor from Company Z who is in charge of reading the incoming messages, verifying their format and Net-etiquette (intent and conditions of forums), and publishing them. The moderator is also responsible for assuring that messages do not insult "competitors". Such mechanisms differentiate the forum from other tools of instant messaging such as chat rooms. After one year of operation, however, all the messages meet the required standards, and the idea is to revise the role of moderator.

A final important issue concerning the characteristics of the portal is the program Pro-Activity, which underpins all the channels. It is a program for providing scores to those users (salespeople) who have contributed to the development of information/knowledge accessible through the portal. Such scores correspond to a position in a general classification and eventually they are related to a premium prize. Salespeople can earn points through participating in courses, through providing interesting information for the community, and through solving another agent's problem. This mechanism is particularly coherent with the personality of salespeople given their aim of being the "best in the class". At the same time, the competition helps in facilitating the sharing of information.

The initiative represented an extremely high level of innovation for Company K, for several reasons: the *relationship of sales people with Company K* is now closer and different- Company K is one of the sources of knowledge for salespeople, and salespeople can now be more important actors in Company K processes. Secondly, the *relationship with new technology*: salespeople have had to learn to use new technology and the new functionalities available through the web. Thirdly, the relationships *among people belonging to the community*: through the web, salespeople have changed their approach to one another. They are still competitors but they are also collaborators- exchanging ideas and information, and so learning. Finally, they are changing the *relationship with the customers:* from their side they are providing the customer with a richer product/service of a higher quality and, on the other side, the customer is seen as a source of knowledge.

This description of the functionalities of the portal is extremely important in order to understand, in the following section, the characteristics of the configuration, its evolution over time, and the effects on performances.

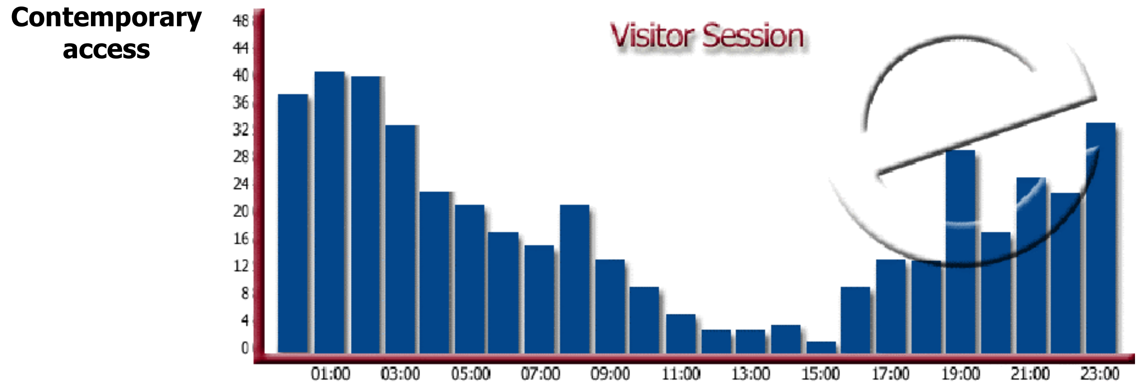
The results

Impacts concerning business and people performances, six months after the implementation of the community, have been measured by the researcher and by Company Z. Results have been gathered considering two separated issues: the first one concerning the performances of the portal (in terms of number of accesses, or time of connection, visitor session); and the second concerning the impact on Company K's strategic goals.

As shown in figure 8.5, the *number of accesses* to the community has grown incredibly. From the 20th of February 2001, when the tool was introduced, the number of salespeople connected had grown to 1250 by the 15th of September 2001. This means that most of Company K's agents are connected to the community. In terms of the *frequency of access,* it has been found that 40% of the agents access the community every day, and they are connected on average for 22 minutes, but this value increases when training sessions are periodically run. Finally in terms of visitor *session*: in figure 8.5, the number of contemporaneous accesses during a day is reported. It is clear that people dedicate part of their spare time to getting information or to discussing their work with other members of the community. This means that they evaluate the portal in a very positive way: the kind of information that they get from the community is useful for their daily activities.

Through interviews within the company, Company K has measured some changes in performances even after six months:

1. Reduction of personnel turnover. Company K has seen, over the first 6 months, a reduction in salespeople turnover from 50% to 17%. This is an important result as it is an essential prerequisite for Company K to start investing in building and fostering the creation of a common body of knowledge of its sales force.
2. Development of a professional profile by the agents. The web site has collected feedback from agents who got the information they needed to address a specific request of a customer from the community. The improvement of agents' profile, and the possibility of building a network of competences, is a real asset for the company.
3. Better sales forecasting. Improving the communications with the sales people, and reducing their turnover, allows Company K to have a better knowledge of the market and its dynamics. This leads to better forecasts of sales and turnover.



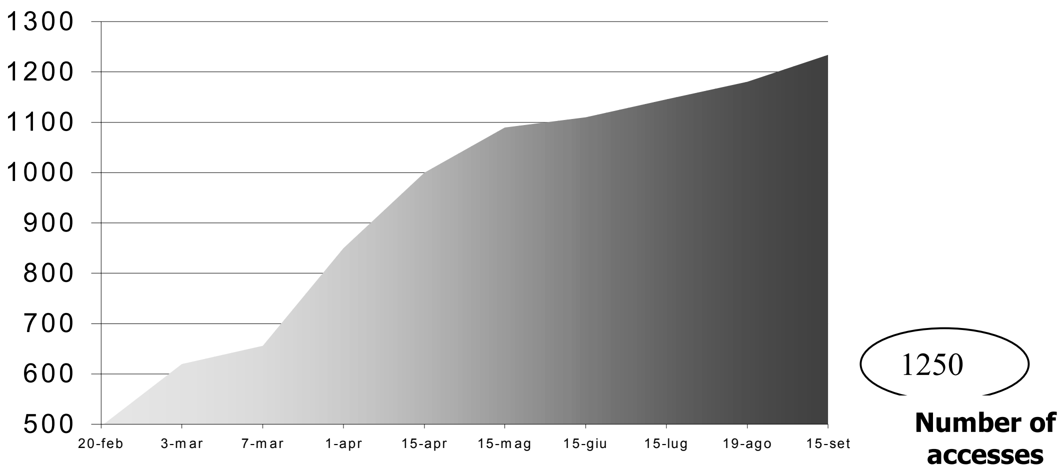


Figure 8.5: Performances of the portal

The action research process

In order to begin the analysis of the case over time, it is necessary to explain in more detail the action research process that was adopted. The action research has been carried out by the researcher acting together with both Company Z and Company K, in the different phases of development of the portal. The interaction between the researcher and the companies was organised as shown in figures 8.6 and 8.7. In figure 8.6, in particular, the different actions taken in the case are described from the perspective of the researcher acting with practitioners, and in acting alone. It is important to note that, in order to develop preliminary theory, the action research took place according to the process described in the previous section (in terms of joint definition of hypotheses, determining which actions to take, checking the effects in terms of performances and development of preliminary theory). In figure 8.2, at each stage of development, the performances of the knowledge management system have been assessed according to model developed in the explorative research (Chapter 5): that is, knowledge process performances (in terms of frequency of behaviours), people performances and business performances. The interviews with Company K and Z personnel have been conducted according to the questionnaire also used for the case studies (appendix 3).

A survey involving sales people and then checking their feedback about the configuration is reported in appendix 4.

Researchers and practitioners	***Researchers***
Preliminary meetings with company K and Z: to check the goals of the company, to analyse preliminary barriers for the development of the knowledge management configuration	Development of preliminary list of propositions to refine
Periodic meetings of researchers together with company Z (once a month): in order to check the evolution of the functionalities of the portal over time, and the performances (especially concerning the performances of the portal and the knowledge process performances). During the meetings, the impact of the functionalities of the portal (and of the overall configuration) on salespeople behaviours have been analysed and discussed	Development of preliminary theory about the interaction of levers within the configuration and its effects on knowledge process performances.
Meetings of researchers together with Company K and Z (once every two months): in order to assess the effects of the overall configuration not only on salespeople behaviours, but also on people and business performance, and the problems of the company in integrating the configuration in the overall company structure.	Development of preliminary theory about configurational change and its effects on people and business performances, theory about effects of the configuration on innovation strategies.
Survey on the portal to get feedback from salespeople (appendix 4) five months after the introduction of the system	Check the use of the portal, check knowledge process performances and people performances
Telephone interview to sales people to gain feedback on the usability and usefulness of the KM configuration (three months after the introduction of the system)	Check the use of the portal, check knowledge process performances and people performances.
Monitor the portal through a password, and interact with managers of company Z in order to understand the choices made (for three months).	Check the use of the portal, check knowledge process performances and people performances, develop preliminary theory about the interaction of levers within the configuration.
Participation in public presentations of Company K (after 10 months)	Check the external promotion strategy of the company. Check the innovation strategy of the company

Figure 8.6: The interaction between the researchers and practictioners in the action research

Figure 8.7 represents the actions taken at different times during the action research process.

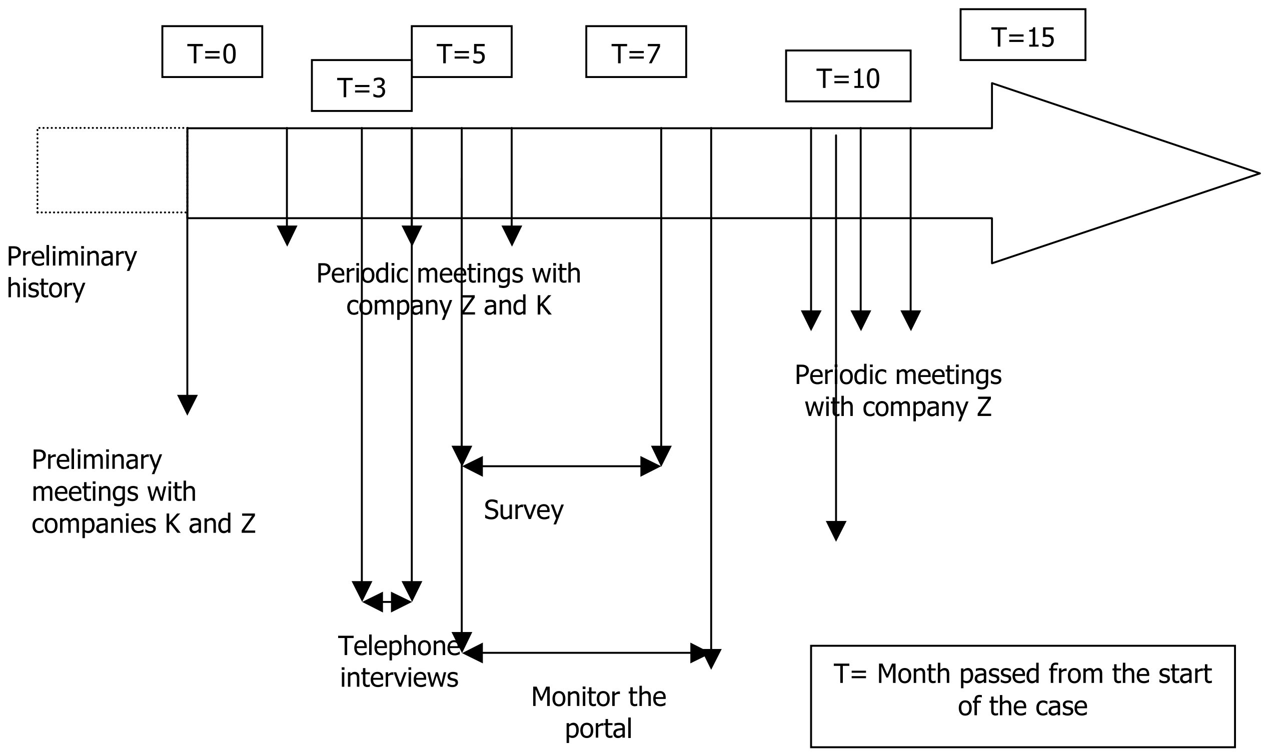


Figure 8.7: The action research process over time

8.4 THE PHASES OF THE DEVELOPMENT OF THE KNOWLEDGE MANAGEMENT SYSTEM

The first step of the research has been, together with the managers of Company K, to discuss the propositions concerning the configurational change to be refined, considering the propositions developed in the longitudinal case studies (Chapter 7) [2].

The process of configurational change in the case of Company K (which in this case is the implementation of a new knowledge management system) can be modelled as four phases, described in detail in this section:

1. Concept of the portal
2. Introduction of the portal
3. Consolidation of the knowledge management system
4. The next steps and challenges: integrating the system into the company organisation

Concept of the portal

The main idea by the company was to develop a tool to develop salespeople's knowledge about products, services, market and competitors. Thus, in this first phase, the work team, which included managers from both the company's sales departments and Company Z, focused on learning and information tools for delivering "useful" knowledge to salespeople. Although a careful activity for software selection was carried

[2] According to the characteristics of the case, the propositions top refine concern the decentralised approach.

out, and a prototype developed, most of the consultants' efforts in this phase were not devoted to the technology but rather to understanding and building a relationship with salespeople. Firstly, members of the team joined some of the agents in their daily work for two weeks in order to understand their task, needs and habits; then a very open and flexible prototype was developed that was discussed and refined with the agents; and finally workshops, meetings, and a road show were organised to build awareness and train the salespeople. The result of this phase was knowledge, developed by Company Z and Company K, about: the typical behaviour, personality, and priorities of sales people; the type of knowledge/information they need to carry out their job; and their difficulties in using web-based tools.

Merchandising and communications events were also heavily used in this phase to build ownership and sense of belonging.

Introduction of the portal

During the second phase, the team aimed to create a community of salespeople free from hierarchical relationships. The facts that all the agents were given full access, that the site was maintained by an independent company outside the firewall, and that the rules of the official ICT infrastructure of Company K were not in place in the management of the portal, played a key role. One of the key issues in this phase was to overcome user resistance related to the lack of IT skills: online and offline ad hoc training was offered, and extremely "easy-to-use" and light functionalities were developed. The consultancy company forced the IT developers to focus on "usefulness" and "flexibility and lightness" rather that on graphics and technical sophistication. As one of the members in the team noted:

"…most web designers act as if they develop sites for their peers rather than for the users, we were very careful to avoid it…".

A dedicated team of people was in charge of scanning knowledge sources, translating them into readily usable "knowledge pills" and publishing and stimulating discussion (especially concerning competitors' products, services, and technical characteristics).

"Our people are travelling around and working like hell. They don't have the time or the will to read papers and journals. They want us to extract what they need to know to succeed in front of the customer".

The team in charge of scanning knowledge and managing the portal involved several personnel from both Company K and Company Z. However, they were not perceived as hierarchical references: some of them were seen as facilitators (Company Z), others as the sponsors (Company K). In more detail:

- *Company K- responsible for customer development*, who sponsored the development of the knowledge management system, and participated in the detailed design of the solution also following all the development steps.
- *Company K- portal responsible*. The person filling this role worked in the customer development department, but also had a strong experience in the HR department, especially in the training group. She was in charge of all the development activities to salespeople: the development of the portal, and the overall KM system. This role actively participated in all the initiatives for salespeople and was the main interface with company Z, often working at their site.

Also within Company Z, several roles were identified. Some of them were directly related to being in charge of maintaining and supporting the functionalities of the portal: responsible for training, web designer and information monitoring manager. Others were specifically in charge of developing the portal and managing the interaction with users:

- *Managing the relationship with users of the portal*: in terms of collecting suggestions, sending out personal communication, collecting eventual claims about Company K and forwarding them to managers.
- *Access manager* in charge of the working of the portal from the technical perspective. The portal is dedicated to those agents who have a key, and who are included in Company K lists. Sometimes an unlisted user asks to subscribe to the portal. Company Z then has to check with company K. The access manager is responsible for the correct technical performing of the portal, which goes beyond the portal, to include PC problems. The access manager also provides distant support for such problems. By exploiting this support, salespeople can begin to overcome their lack of familiarity with the technology.
- *Tutor*: the tutor is mainly leading the training processes included in the portal. The main task is to help those salespeople who have problems with courses to successfully pass the exam. Although this role is one of the services offered by the portal, and several people have received such support, it is not an institutionalised role. At this stage of community development, the tutor is only in a support role, as the only online courses are IT ones.
- *Community development manager*: the gatekeeper between company K and company Z, analysing the community in terms of quality, satisfied requirements, periodical access; and forwarding these results to Company K. This manager is also responsible for "improvement and innovation" of the functionalities of the community. Company Z's community development manager is the person who worked, in the previous stage, on identifying the "useful" knowledge for salespeople. In this second stage, rather than a formal development manager, the role of community development manager is more of a project leader, responsible for the implementation of the community and for the relationship with Company K.

The clear definition of roles within the knowledge management configuration, as will be described in the following section, will help Company K to improve the functionalities of the levers of the configuration in line with new perceived requirements emerging from the community, and at the same time facilitates the creation of common references for salespeople acting in different organisations (TBP).

The points competition stimulated people to read reports and attend online courses. Official certificates were provided for courses attended. Although prizes and certifications played a role, the most important stimulus for participation was that the salespeople would to be recognised as "first in class". Interviewed salespeople stated that being high up in the classification became a powerful source of status in the community and self-esteem. Soon the contest, and the system, became very popular in the community. Although interaction was mainly through the web, "real" meetings and conventions played a key role in the development and consolidation of the community.

"During conventions and events, people are really happy to meet people they interacted with on the web. The best knowledge sharers and the winners of the contest discover themselves to be extremely popular and are welcomed as heroes, hence the virtual communities become real and people that are yet to be invited decide to join".

Consolidation of the knowledge management system

The aim of the third phase of the development is twofold: to consolidate participation in the community, and to create a strong connection between the company and the community in terms of increasing the sense of belonging. The requirement to understand the rational of company strategies and policies that could influence their activities emerged from the community. The work team developed improvements for the portal: firstly, a specific "offer channel" where all the information about products/services of Company K and of its competitors could be easily accessed and retrieved, and moreover provided more managerial training courses both online and offline. This required a formalisation of dedicated roles (as tutors) within Company Z. Further, a "direct line with marketing" service, a dedicated set of online conferences where the person responsible for company K's marketing B2B activities discussed the strategies and practices, and answered questions from the community, was established. The availability of such enablers builds up a strong sense of belonging to the company: several external presentations were organised by Company K, also inviting members of the community to discuss their experience.

People from the company's marketing department progressively became more aware of the very high potential of the system to become a source of knowledge about the market and competitors. Online surveys now provide marketing with quick and useful insights and information that they use to improve their offers. Although developed as a learning tool for salespeople, the portal and the community were awarded as the best marketing tool in 2001 by the ADICO association (Italian association of commercial and marketing directors).

The contribution of the system to the sales process is today becoming more evident as communication is shifting from reporting information and experiences, to collaborative searches of possible solutions to problems. The performance competition now offers high points for the joint solution of common problems within the community.

"From time to time we launch a survey asking "who helped you most" by answering through the forum and/or contributing with information and success stories. Results are published and the winners are acknowledged and given extra points …"

The next steps and challenges: integrating the system in the company organisation

The work team is now carrying out a fourth phase, which is a real challenge for the community. In the earlier phases, the community was kept separated from the rest of the organisation. This has protected it from hierarchical intrusiveness and misalignments from the real goals of salespeople. However, at this stage, the managers of Company K are challenging to gain recognition of the community within the company organisation itself. As the system has progressively been recognised, and eventually rewarded as a powerful marketing tool, more and more people in the company are asking for the extension of the system to involve more users and cover more market segments. Salespeople are increasingly asking for the system to include more operative functionalities to support them not only in terms of knowledge sharing, but also as working tools supporting their daily administrative and operational process even when they are at the customer's site. To facilitate this, wireless functionalities have been added to the system allowing the salespeople to receive documents and notifications when not connected to a fixed workstation. The work team is aware of the implications of this pressure in terms of the needs for a tighter integration with the company's official information infrastructure, and is worried about the possible implications and constraints of this. Further, as more users become involved and functionalities become more sophisticated, costs will rise and the system cannot be maintained purely on the budget of the sales department. This means that a more rigorous estimation and quantification of the performances and the effects of business process will be required.

Finally, there is a growing concern about the role played, or rather "not played", in the system by the salespeople's employers. So far, these have not been involved, and initially they "accepted" the system because it provided them with free training and helped in lowering the turnover. Now, however, they are beginning to perceive that the system is becoming very central to the agents, changing the network of communication and relationships among the agents, and between them and the company, ultimately challenging their own role and source of power. There are already signals about the possible implications of the system, and growing concern is emerging among employees. The work team is aware of the need to rebuild trust and regain employers' "buy-in".

In figure 8.8, for each phase, the implemented knowledge management system is summarised and related to the main characteristics of knowledge processed within the community, and the key benefits, which will be discussed in detail in the following section, outlined.

In the following section, these results will be analysed in order to answer the third research question, and to refine the propositions on configurational change and its effectiveness.

Phase of development	*Key actions taken*	*Characteristics of knowledge*	*Users' key benefits*
1.Concept of the portal	The team works together with sales people in order to understand their priorities and "useful" knowledge.	Tacit knowledge accumulated by individuals	
2.Introduction of the portal	Focus on transfer of useful knowledge (through training and informative channels) to stimulate discussion Fostering access to the portal through incentive systems (contest and certification) Link to offline initiatives	Creation of tacit knowledge accumulated by individuals through direct interaction with customers Transfer and sharing of explicit knowledge about methodologies	Assimilation of knowledge about products and competitors that is very useful in managing the relationship with customers Higher self-esteem
3.Consolidation of the knowledge management system	Focus on interaction within the community through the community channel and offline initiatives Participation of Company K managers in the community External promotion	Creation of causal knowledge through understanding motivations Storing of knowledge at a community level	Sharing of knowledge within the community Ability to abstract and generalise knowledge Satisfaction on approaching the customer Strong sense of belonging
4.Next steps and challenges: integrating the system in the organisation	Integration with Company K organisation Performance measurement of the community External promotion	Sharing of causal knowledge	Sense of belonging Recognition within the company Low staff turnover

Figure 8.8: The phases of development of company K knowledge management system

8.5 DISCUSSION OF THE ACTION CASE AND RESULTS

The action research case provides results concerning RQ3, in a specific research setting, in terms of:

- The evolution of the internal configuration of levers
- The development of the community
- The type of knowledge managed
- The evolution of the knowledge performance
- The alignment with the innovation strategy
- The barriers to configurational change and to its effectiveness.

Each of the topics is discussed in more detail in the following subsections.

8.5.1 The evolution of the internal configuration of levers

In the previous section, the phases of development in the knowledge management system have been described, in terms of the main goals, the levers implemented, and specific results.

In figure 8.9 the configurational change is represented. The levers aimed to develop a virtual space for knowledge transfer and sharing among salespeople, recreating the context that is absent in the case of dispersed working, and building the awareness of being part of a community. All workers were asked to perform their selling activities and interpret them as an opportunity to develop knowledge to share with others. The target configuration has the functionalities of a "decentralised approach". Analysing the changes from one phase to another it emerges that the change is incremental, adding or refining the functionalities without changing the overall approach, which is aimed at creating and diffusing the responsibility for knowledge processes among the salespeople. In terms of system evolution, the work team of Company K and its consultants (Company Z) have been *flexible in building a knowledge management system*: functionalities of the system have been added and refined only when a specific need emerged directly from the users. Therefore, the key driver to the success of the initiative can be termed as the ability of the work team to continuously perceive and understand the needs of the community, and to rapidly provide organisational and technological solutions enabling such requirements.

From this perspective, the ICT solution can be also understood: the technological and graphical choices are very simple, but at the same time very flexible. ICT is therefore only a neutral field for communication where salespeople belonging to different organisations (TBPs) and in competition, can share knowledge. It maintains its neutrality even when the person responsible for B2B marketing in Company K becomes involved in the process, as his contribution is interpreted by the people in the community as an effort by Company K to develop their competencies and improve their work. The organisational and managerial mechanisms are designed not only to facilitate knowledge processes but also to understand the community requirements and to reactively refine the knowledge management system. In more detail, the mechanisms aimed to:

- Facilitate knowledge processes: enhancing the use of the portal, stimulating the transfer of knowledge by each salesperson, stimulating knowledge sharing, creating alignment with corporate goals (of Company K), creating awareness of being a community.
- Build a structure to manage the knowledge management system: to monitor the evolution of users' needs from the knowledge process point of view, and measure the results and promote them within the community and in Company K at large.

Phase	ICT	Organisation mechanisms	Management systems	Key performances
1.Concept of the portal	Awareness through prototype	Involvement of Company Z in the design and development of the platform. Definition of Company K portal responsibilities (marketing and training competence)	Off line training Focus group to find "useful" knowledge for agents Preliminary investigation to analyse characteristics of sales process and agents Preliminary meetings to promote and create awareness (off show)	Strong commitment of company K Interest of agents
2.Introduction of the portal	Informative, training and communication functionalities Technews, online training courses on IT and technical characteristics of product, moderated forum	Definition of roles in Company K and Company Z. Improvement and development team allocated.	Relationship between the portal and off line initiatives Training courses Publication of useful knowledge in order to stimulate discussion Pro activity program Tutorship for the use of the portal Participation of company K responsible in offline programs	Assimilation of knowledge Increased self-esteem
3.Consolidation of the knowledge management system	Creation of offer channel Development of "direct line with marketing"	Stronger involvement of Company K roles Business marketing responsible involved.	External meetings and conferences involving Company K managers "Direct line with marketing" Large number of meetings and conventions among sales people Premium prizes for solution of problems	Sharing of knowledge Abstraction and generalisation Satisfaction on approaching the customer Greater sense of belonging
4.Next steps and challenges	Development of wireless applications Evolution of the tool as a working tool Integration of the KM system in company K knowledge management system	Involvement of Company K Human Resources unit Involvement of TBPs	External presentations of the project Evaluation of company K internal channels for presentation Measure of effectiveness results in order to evaluate the impact on company K sales performances	Sense of belonging Recognition within the company Low staff turnover

Figure 8.9: The functionalities and solutions of levers in the configurational change

The interesting issue is that these enablers have been designed and refined together with the ICT portal, and not separately. This flexibility, which is one of the keys of success of the knowledge management system, hinders the diffusion of the system itself: the system has been developed only for salespeople, using the budget of the sales unit and improved according to requirements of users. Specific characteristics of the overall organisation of Company K, and of TBPs, have not been considered.

From the results concerning the configurational change, and its effects on performances, the following propositions can be derived:

P3.7 If a decentralised approach adopts levers that address the priorities and values of the users, and that is focused only on the management of knowledge useful in carrying out their business activities, then it is successful in terms of involvement, in seeing activities as opportunities to develop knowledge (B2), and to encourage the use of spare time to generate knowledge (B3).

P3.8 If ICT functionalities support synchronous communication and collaboration, and the adoption of specific incentives (aligned with people priorities) to stimulate people in sharing knowledge and solving other people's problems, then the configuration is successful in terms of transfer and sharing of knowledge between and among processes (B4 and B5).
P3.9 In a decentralized approach, if ICT is flexible (in terms of refining and adding new functionalities in order to meet new requirements from people acting in the knowledge processes), and also other levers can be adapted to suit, then the decentralised approach is successful in terms of the generation of knowledge (B2 and B3) and in terms of role recognition and work satisfaction.
P3.10 The refinement of a knowledge management configuration to meet the requirements of a specific functional unit hinders the diffusion of the configuration throughout the company and its integration with consolidated practices.

8.5.2. The development of the community

The goal of Companies K and Z was to develop a community of salespeople supported by an implemented knowledge management configuration. Literature addresses the issue of the *relationship of the community with the formal organisation* in terms of the *process of creation,* as communities are not created but rather evolve outside the domains of formal management practices. Managers can only support and facilitate (or not) the process of creation through the implementation of enablers. Another element is the *control of the community*: as Wenger and Snyder (2000) observe, managers can foster learning in communities but they cannot control such process. Further, communities can have difficulties in communicating with the rest of their organisation (Schein, 1996) as they usually develop different languages, values, and knowledge (Magnusson and Davidsson 2001; Brown and Duguid, 1991).

Considering the configuration of levers, in the first two phases, the focus of the implemented enablers was on the process of *creation - building the awareness of the community*, in term of interests, practices, routines and language. The managers acted only as sponsor of the initiative. In the final phases, the focus is *on building integration mechanisms with the formal organisation*.

The effects of the configurational change, and the characteristics of the community developed, also emerge through the analysis of performances in the case. The frequency of salespeople behaviours evolved into different directions as indicated in figure 8.10.

In the two first phases, behaviour B8 was very frequent: salespeople were very interested in accessing knowledge from external sources through the information and training channels. From the second phase on, behaviours B5, B7, and B2 become more frequent. These behaviours represent the extent to which knowledge activities (acquisition, sharing and transfer of knowledge within the community itself) are performed within the community. Then, from the third phase on, B8 becomes less frequent and, and behaviours B1, B4 and B6 become more frequent. Underpinning these behaviours is the extent to which the community relates to Company K's organisation in carrying out knowledge processes. This changing focus is somewhat coherent with previous observations: at the beginning the focus of the work team was on providing "useful" knowledge to salespeople, then Company K fostered the awareness of the community and the flows of knowledge transfer within the community itself, despite the fact that the members belong to different organisations (one in competition with the other), and without dealing with the issue of recognition and relationship with the existing Company K organisation. In the final two phases, the company challenged the connection between the community and the organisation, facilitating the interpretation of causal links. In order to address this issue, the managers of Company K have had to deal with: the strategic potential of the community, the integration of the community into the overall KM system of Company K, and finally the development of the portal as a working tool. The challenge is not to denature the characteristics of the community itself (subsection 8.5.7).

Phase of development *Behaviours*	*Concept of the portal*	*Introduction of the portal*	*Consolidation of the KM system*	*Next steps and challenges.*
B1: Individuals use the organisation's strategic goals and objectives to focus and prioritise their improvement and learning activities	--	--	+	+
B2: Individuals and use selling activities as opportunities to develop knowledge	-	+	++	++
B3: Individuals use part of available time/resources to learn	-	+	++	++
B4: Individuals integrate knowledge among all different phases of the selling process	--	--	0	+
B5: Individuals transfer knowledge among different processes in selling company K products	-	0	+	+
B6: Individuals abstract knowledge from experience and generalise it for application on new processes	-	0	+	+
B7: Individuals embed knowledge into vehicles	-	0	+	+
B8: People try to assimilate and internalise knowledge from external sources	++	++	0	0
++ very frequent *+ frequent* *0 rather frequent* *- not very frequent* *-- not frequent at all*				

Figure 8.10: The frequency of behaviours of sales people

From this analysis, the propositions are formulated as follows:

P3.11 The decentralised approach fosters the creation of a community
P3.12 If the decentralised approach fosters the creation of a community, and it creates the awareness of the community itself in terms of interests, practices, routines and language; then the members of the community start to use business activities as opportunities to develop knowledge (B2), to transfer knowledge among different processes (B5), and embed knowledge into vehicles (B6). At the same time, they reduce the frequency of assimilating knowledge from external sources (B8).
P3.13 If the decentralised approach fosters the creation of the community, and it builds integration mechanisms with the formal organisation, then the members start to use the organisation's strategic goals and objectives to focus and prioritise their improvement and learning activities.

8.5.3.The type of knowledge

In Company K, the type of knowledge supported changed over time.

In the specific case investigated, all the dimensions of classification need to be taken into account:

1. *The level of explicitness of knowledge* (Nonaka and Takeuchi,1995): in terms of tacit and explicit knowledge;
2. *The knowledge object*. In the case of Company K, the *solution* concerns: the characteristics of the customer (priorities, goals, needs, history), the specific behaviours or attitudes of the customers towards Company K's offer/services, the characteristics of the selling process towards such customers (difficulties, barriers…), the characteristics of the competitors and the environment. Knowledge about the *methodology*, on the other hand, refers both to how to perform selling activities (i.e. approach the customer) and "acting in a community" (Brown and Duguid, 1991). It represents all the characteristics, languages and skills needed to act in the actual community. Knowledge about *motivation* concerns the rationales behind specific selling choices, which may be referred to Company K's strategic priorities, culture, and organisation.
3. *The level of abstraction and generalisation*: which refers to contingent or general knowledge if a classification of similarities among cases is developed.

The map of changes over time in the types of knowledge supported by the configurations is represented in figure 8.11.

Phase of development *Knowledge object*	*Concept of the portal*	*Introduction of the portal*	*Consolidation of the knowledge management* system	*Next steps and challenges: integrating the system in the organisation*
Issue/motivation			Explicit contingent	Explicit contingent
Methodology	Tacit Contingent	Explicit Contingent	Explicit Generalised within the community	Explicit Generalised within the community
Solution	Tacit Contingent	Explicit Contingent	Explicit Generalised within the community	Explicit Generalised within the community

Figure 8.11: The change of types of supported knowledge

As represented in figure 8.11, the type of knowledge involved in the community changes over time. Initially, knowledge about solutions, customers and sales methodologies, was stored tacitly by salespeople through direct interaction with customers. In phase 2 (Introduction of the portal), as a result of performance measurement, salespeople began to assimilate knowledge and to generate tacit knowledge, which was stored in everyone's memory. Company Z transferred explicit knowledge to the community about possible solutions by scanning potential external sources of knowledge. Histories and experiences are transferred, conversely, by the salespeople (knowledge about methodology) concerning both the approach to the customer and the usability/usefulness of the portal. ICT, in fact, mainly supports communication, while roles and incentives are designed to foster such communication, and to overcome initial inertia and lack of trust.

It is important to point out that, at this stage, abstraction and generalisation had not taken place in the community; knowledge remained contingent. Abstraction and generalisation were carried out by the consultants working with company K, who used to derive lessons for Company K and for the community about experiences coming through the portal. In the following phase (consolidation of the configuration), tacit and explicit knowledge creation was fostered by joint solutions to common problems through ICT. ICT supported the communication, incentives the solution of joint problems, while roles and training facilitated the abstraction and generalisation of knowledge within the community. The availability of knowledge concerning the causes of specific events and choices, and support in recognising and explaining such links, was the real challenge of this stage. Managers in Company K were therefore changing their role from that of sponsors to one of facilitators of the process. From the performance point of view, behaviour B6 (Individuals abstract knowledge from experience and generalise it for application on new processes) was much more frequent during this phase. During the final stage, performance measurement and increased promotion strengthened this process. Connecting the community to the company facilitated the better understanding of cause-effect relationships.

One issue that is extremely relevant is the relationship between knowledge assimilation, transfer, and sharing acting through the portal and the community; and creation of tacit knowledge in interacting with the customer. The latter was the only knowledge process encouraged before the development of the knowledge management system. Through the transfer of issues and methodologies, fostered by the portal in phase 3, the creation of knowledge through the interaction with customers can be at a causal level (rather than only declarative or procedural). Therefore, providing explicit knowledge about issues can facilitate the generation of new tacit and causal knowledge, derived from the interpretation of experiences through these motivations. This process can enable a virtuous cycle: through providing issues, new causal knowledge is generated and new solutions and methodologies transferred. So the community can either stimulate explication and transfer of knowledge, or facilitate the transfer of issues and the generation of tacit causal knowledge.

It is interesting to note how the portal acts as a tool to generalise knowledge through the exchange of experiences. In Chapter 5, it was seen that, in decentralised approaches, one way to generalise knowledge was based on interacting with experts. Through the portal, the generalisation of knowledge can also take place within a community where everyone can become an expert thanks to the combination of expertise and understanding of motivations provided by the community itself.

From the results, a set of propositions is derived:

P3.14 In a community, if ICT enhances the communication, and incentives and performance measurement systems foster the joint solutions of problems, and the involvement of roles and training support the understanding of motivations/issues; then the decentralised approach is effective in terms of abstraction and generalisation of knowledge (B6), and sharing of knowledge within the community (B4 and B5).
P3.15 In a community, provided a decentralised approach supports the transfer of explicit knowledge about motivations, the configuration is effective in terms of generating new tacit and generalised (causal) knowledge.

8.5.4.The evolution of knowledge performance

The implementation of the configuration of levers in the different stages of development fostered an improvement of performances of the knowledge processes. Beyond the improvement of the learning behaviours (as discussed in subsection 8.5.2), with specific reference to some of them, people and process performances also improved. In terms of *people performances*[3], three dimensions have been fostered by the implementation of the portal. Salespeople have increased their *self-esteem* through more successful interaction with the customer. As they own knowledge about competitors and products/solutions, they can provide the best solution to the customers and improve their visibility within the community. People also increase their *satisfaction in working in a community* in terms of the sense of belonging and the level of collaboration. Brown and Duguid (1991) noted that a critical skill for community members is to learn to interact with others within the community itself. Moreover, the *level of satisfaction of people operating in the organisation* has also improved. Despite the sales people being employed by TBPs, through interacting in the community in the third and fourth phases, they have developed a strong sense of belonging to Company K values, with a consequent reduction in turnover (50% to 17%in six months).

Positive effects have also been measured on process performances, specifically in terms of market share and customer loyalty. Managers of Company K noted that the market share has been maintained at 60%, despite an increase in competitors, and that customers were very satisfied with the acquired products in terms of meeting their required characteristics and the competences offered by salespeople.

Observing the evolution of performances typologies in the case, it seems that a virtuous cycle has been created. Initially, the main focus of the company was clearly on "fostering learning though the creation of a community". This directly facilitated the salespeople in approaching and managing the customers. The success in carrying out their work, their desire to be "first in class", and to increase their self-esteem, were a stronger incentive than any formal mechanism.

From this, further propositions can be drawn:

P3.16 If a decentralised approach supports the creation of a community, it will result in improved people performances in terms of higher self-esteem and greater satisfaction with working in a community.
P3.17 If a decentralised approach supports the integration of the community in the company, it will result in improved people performances in terms of a greater sense of belonging and a lower staff turnover.
P3.18 If a decentralised approach supports the development of the competencies of salespeople, and knowledge process performances and people performances also improve, then the effects on business performances will be improvements in terms of market share and improvement of customer loyalty.
P3.19 The awareness, measurement, and recognition of individual success (on business performances) due to participation in a decentralised approach, is an incentive to participate in the system.

[3] The survey submitted through the portal was aimed at assessing people performances. Results have been checked through telephone interviews.

8.5.5.The alignment with the innovation strategy

The innovation strategy of Company K is related to the development of new telecommunication services. Although acquiring some contributions from external actors, the R&D unit principally owned the innovation process. Company K managers, at the beginning of the process, perceived the creation of the community of salespeople as a commercial tool focused on selling activities. However, in the third stage of evolution, the managers discovered that the contributions by members of the community were essential in making their decisions. Top managers of Company K, through their intervention in the community, have realised the potential value of knowledge coming from the community, especially concerning the customer (in terms of requirements, trends, feedbacks about the use of the product). Ideas coming from the community have been discussed by the marketing unit and also by the R&D unit. Preliminary product solutions, developed by the R&D unit, have been submitted to the community through the portal in order to obtain useful opinions for the development phase. In 2001, the knowledge management system received the prize for best marketing tool in Italy.

From the research point of view, these results show how the implementation of a new knowledge management system enhances the refocusing of an innovation strategy. In particular, the creation of the community of salespeople, and its integration with the marketing organisation, fosters the possibility of exploiting feedback coming from the market in the overall product innovation process (Bartezzaghi et al. 1998). An innovation strategy based on high level of innovativeness and customisation in the sales unit, and the involvement of the customer as a source of innovation, drove the selection of a decentralised approach: the basic assumption of Company K was that fostering knowledge transfer and sharing within the community would facilitate the generation of complex and innovative solutions for the customer. However, through realising the potential of the community as a source of knowledge for new service development, the innovation strategy of the company changed: from the company perspective, the community became a "marketing tool" for anticipating customer trends and requirements and for developing new innovative products/services.

This leads to a fresh proposition:

P3.20 The adoption of a decentralised approach drives companies to refocus their innovation strategies in terms of exploration strategies and the involvement of external sources in the innovation process.

8.5.6 The barriers to configurational change and to its effectiveness

Company K has preliminarily identified and managed barriers to configurational change. In particular:

- *Familiarity with technology*. As noted for Company I, unfamiliarity with ICT can be a strong barrier to change, especially when change relates to introduction of new ICT functionalities. Such a barrier seems to be most relevant to the education and culture of the people involved in the change: salespeople are usually undergraduates who have traditionally based their work on managing relationships with their customer. Technology has always been perceived as a separation between them and their customers, and face-to-face relationships have always been preferred, especially in Latin communities (Hofstede, 1980). Nevertheless, the functionalities of new technologies, combined with traditional selling activities, can enrich the job of salespeople, as was found in Company K. Managers at Company K and Z were extremely sensitive to this problem, and put a lot of efforts into understand the status of ICT skills of salespeople, and in teaching and supporting them in using the tool.

This leads to the following propositions:

P3.21[4] If ICT functionalities are developed in order to build a decentralised approach, the barriers to change are: the level of unfamiliarity of the users, related to the education of people, their culture and type of job.

P3.21.1 If new ICT functionalities are introduced in the knowledge management configuration, and if other levers are implemented in order to assess the level of unfamiliarity of the users with the new functionalities and to improve their technological skills, then the decentralised approach is effective in terms of: assimilation of knowledge from external sources (B8), involvement through seeing activities as opportunities to develop knowledge (B2); transfer of knowledge within and between processes (B4 and B5) and embedment of knowledge into vehicles (B7).

- *Slack, and combination with operational activities.* Slack, and the availability of time for knowledge processes have been identified as relevant enablers for learning (Gieskes, 2001). In the case of Company K, as signalled in figure 8.4, most of the access to the portal was between 1.00 a.m. and 4.00 a.m, and not during working hours. Managers were amazed at this, that people used to dedicate their private time to participation in the community. This is a very important result for two reasons: firstly, it shows that salespeople perceived participation in the community as extremely important and useful for their working and professional growth. It means that Company K and Z have been extremely successful in identifying the really important value of salespeople, which is common to most people: to be "first in class". From the research point of view, it shows that slack in operational activities is not a necessary condition to enhance knowledge processes. The lack of slack in operational activities is a barrier to knowledge processes, but it can be overcome through designing the functionalities of levers in the configuration so as to manage the knowledge that is useful to people acting in the knowledge processes in order to realise their professional and personal goals. Aware of the effort made by people in dedicating their personal time to knowledge processes, Companies K and Z developed wireless facilities in order to facilitate the access to the portal also during the day. The effect was threefold: accessing the community from a customer's site gave the impression of being a highly technological and skilled company, it improved the quality of life of the salespeople by facilitating access during the day, and finally it improved the sense of belonging to the community and to company K. This leads to the following proposition:

[4] The propositions concerning the barriers are organised as follows: a first proposition indicating the barrier hindering the effects of levers on performances and a subpropositions indicating which levers facilitate overcoming the barriers and enhancing the effects of the configuration on performances.

P3.22 The lack of slack for accessing knowledge processes is a barrier that hinders the effects of levers on performances.
P3.22.1 The decentralised approach in which ICT functionalities facilitate the better organisation of business activities and the creation of slack, and the organisational and managerial mechanisms facilitate the identification of the real priorities for users, stimulates them to dedicate their spare time to act in knowledge processes (B3), and using of business activities to develop knowledge (B2).

- *Competitions among members*. As described in Section 8.3 the members of the community are employed by TBPs, and operate in competition with each other. This could be a very strong barrier to configurational change, as it hinders salespeople in sharing their knowledge with others. Company K managers were aware of this issue at the beginning of the implementation project, but did not manage it directly because this would have influenced the position and strategies of the TBP entrepreneurs. Several functionalities of the adopted levers in the configuration contributed towards overcoming this barrier, with positive effects on performances. Firstly, the *organisational mechanisms* adopted made the community independent from hierarchical levels and from organisational institutional belonging. In the first two stages of development, as described in Section 8.3, in order to facilitate the creation of a community, the interaction was created between members of the community and Company Z, without directly involving the managers of Company K. The members did not perceive any formal relationship with Company K, they only saw the possibility of getting "useful knowledge" from participating in the community. Even when managers of Company K did start to participate in the community, they were perceived of as facilitators and not as hierarchical references. Similarly, the competition among members has been managed through *managerial systems*. Participating in the community is considered a "game": with contests and prizes that can be won, for example through solving each other's problems or for the "best holidays" spent by members. The competition through the portal is played on a neutral field. This allowed the building of *mutual trust* in the community through discovering common interests, joint problem solving and the exchange of experiences, and through off line discussion opportunities. This leads to the following proposition:

P3.23 The potential competition among users of the knowledge management configuration is a barrier that hinders the effects of levers on performances in terms of generation (B2, B3), transfer of knowledge among processes (B5) and embedment of knowledge into vehicles (B6).
P3.23.1 A decentralised approach where no hierarchical formal mechanism is created between the community and the company (organisational mechanisms) and where ICT and managerial mechanisms create a neutral field of competition through the portal and develop a sort of game, fosters the users to transfer within and among processes (B4 and B5), and to embed knowledge into vehicles (B7).

- *Lack of commitment and sponsorship.* A lack of commitment has been identified as a critical barrier to knowledge processes (Gieskes, 2001). In the case studies of Company I and L, it also influenced the effect of levers on performances. In the case of Company K, it is a very difficult issue to assess as, on the one hand, salespeople directly refer to TBP entrepreneurs, while the sponsor of the knowledge management system is Company K. Moreover, in building up the community, the hierarchical relationships could be critical. Company K decided to address this issue gradually: in the first two phases, the main goal was to create the community, and only in the following stages would top managers become involved-in order to foster a sense of belonging, sponsor the initiative, and enhance the creation of causal knowledge (Section 8.5.2). In other words, the main commitment in the initiative was the "usefulness" of knowledge in better performing selling activities, and not formal commitment. This leads to the following proposition:

P3.24 A lack of commitment and sponsorship is a barrier that hinders the effects of levers on performances.
RQ3.24.1 The decentralised approach in which senior levels of the hierarchy do not have formal control, but support the development of competencies, and then become gradually involved in the knowledge processes, can overcome a lack of commitment and sponsorship.
RQ3.24.2 If senior levels of the hierarchy are involved in knowledge processes, then the knowledge management configuration is effective in terms of abstraction and generalisation of knowledge (B6) and alignment of the knowledge processes to corporate goals (B1).

Company K has successfully managed the described barriers. Further barriers have been recognised by Company K that require, in the fourth phase of development, a decision to be taken about the future of the community. The results therefore concern the existence of the barrier. The derived propositions are therefore very preliminary and could be used as a starting point for a new action research case. In more detail:

- *Composition of the community.* Magnusson and Davidsson (2001), indicate how the composition of a community is a critical dimension for its success. Composition refers to both to the number of members and their type. Firstly, in order to start the community activity, a critical mass is necessary in order to build the knowledge base and to make knowledge transfer effective. This barrier has been managed by Company K through the preliminary involvement of Company Z in the community. However, the huge number of people involved could then make interactions more complex. Notwithstanding, the real issue is the type of people involved in the community: at the beginning of the story, the community was addressed only to salespeople. The eventual involvement of TBPs, or other functions of Company K, has been recognised by the company as a potential barrier, which could denature the community itself in terms of common interests, goals and language. The question is whether to allow these additional groups into the community and, if so, with what roles. This leads to the following propositions:

P3.25 The number of members in a community is a barrier, as a minimum number of people need to participate in the knowledge management system in order to enhance the effects of levers on performances
P3.26 The diversity of members in a community is a barrier: potentially they have to share the same interests, language and priorities, in order to enhance the effects of levers on performances.

- *Integration with the organisation.* This barrier is very much related to the previous one, and is implicitly related with the concept of community. According to McDermott (1999), and Brown and Duguid (2000), the role of formal management in the community should be limited to sponsorship, since other formal hierarchical control mechanisms hinder the learning process within the community. However, if the objectives of the community are not aligned with the goals and strategies of the company, the potential of learning within the community is not exploited for the benefit of the organisation.

  Magnusson and Davidsson (2001) claim that a community can only serve as an arena for increased knowledge development and utilisation, if it does not respect the formal processes and goals of the firm (hands-off approach). However, if the company considers the strategic role of the community and an alignment should be established, then several levels of control can be considered: from the definition of interfaces between communities and the formal organisation, through to direct involvement of the management in the work. Company K has enabled the creation of a community, and since it has recognised its potential as a knowledge management system for the overall organisation (beyond the commercial unit), it is considering whether to integrate it with the other functional units. Several elements have to be considered at this stage: firstly, the relationship with the overall ICT structure of Company K, which is much more complex than the infrastructure supporting the community. Then, measuring of value is non-traditional. Wenger and Snyder (2000) highlight how it is very difficult to measure the performances of a community: sometimes the effects of their work are delayed, and moreover the results generally appear in the work of other business teams in the organisation and not necessarily within the community. Further, there is the difficulty in formally rewarding members of the community: this has to be aligned with the policies of Company K and of TBPs, and could also hinder the "game characteristic" of the community. This leads to the following proposition:

P3.27 The integration of the community in the overall organisation is a strong barrier to the effectiveness of the levers on performances. If the priorities and the structure of the organisation, the ICT functionalities, the performance measurement, and the reward systems already available in the company and in the community are not consistent, then the decentralised approach to supporting the community is not effective in terms of transfer and sharing of knowledge (B4 and B5).

- *Integration with sales processes*. As far as the fourth phase is concerned, the community has been to an extent protected from the technological point of view (all the software resides on servers of Company Z and it is moderated and managed by Company Z), from the organisational point of view (as it is not integrated into either TBPs' or Company K's organisations), and from the managerial point of view (as its priorities and incentives are related only to the community itself). At the same time, Company K would like to further improve the use of the tool but, so far, members are accessing the portal mainly during the night. Two possibilities are being considered by the company: firstly, as pointed out earlier, to allow access to the portal through wireless applications, and secondly, to formalise the use of the community for also managing selling processes. In other words, to integrate knowledge and working processes through the portal. This has been addressed as a very critical issue. Wenger and Snyder (2000) have described how communities of practice and formal work groups have different characteristics (figure 8.12). Organisational and managerial levers that support formal group activities are different from those that support knowledge processes within the community. Although the people are the same, they perceive the two activities, as distinct if the system supporting them is different. Overlapping the knowledge management system and the managerial system could be a good opportunity to capture more knowledge concerning selling activities, and to facilitate access to the system during working hours, but at the same time it could denature the knowledge management system. This leads to the following proposition:

	What's the purpose?	***Who belongs?***	***What holds together?***	***How long does it last?***
Community of practice	To develop members' capabilities; to build and exchange knowledge	Members who select themselves	Passion, commitment, and identification with the group's expertise	As long as there is interest in maintaining the group
Formal work group	To deliver a product or service	Everyone who reports to the group's manager	Job requirements and common goals	Until the next reorganisation

Figure 8.12: Differences between communities of practices and formal work groups (Wenger and Snyder, 2000, p.142)

P3.28 The use of a knowledge management configuration to support both knowledge and business processes facilitates the capture knowledge embedded in business processes and creates more slack in business processes. At the same time, it hinders certain functionalities of the implemented levers: the creation of a neutral arena for competition/game playing, and working without a hierarchical component.

8.6 SUMMARY AND CONCLUSIONS

Through the application of action research in the case, certain conclusions can be drawn.

- The first relates to *the role of knowledge management* as the process of designing, implementing, maintaining and improving a system of Organisational mechanisms, Information and Communication technologies and Management systems (the levers). Through these an organisation fosters and focuses individuals' and groups' behaviours in terms of Assimilation and generation, Transfer and sharing, Capitalisation and reuse of knowledge, in both tacit and explicit form, that are useful to the organisation. From the action research case, *two levels of enablers have been identified*: the enablers that directly stimulate knowledge processes, and the enablers implemented to maintain, improve, and revise the previous set of levers in order to access knowledge management performances. The latter set of levers is also implemented by the organisation to overcome the initial barriers to change and its effectiveness. In figure 8.13, the two levels are highlighted: the knowledge management process level, and the knowledge process level (considering also the business process).

From the action research, *three principles* that drive the knowledge management process have emerged:

Identification of users' requirements and priorities to design the configuration. The correct identification of the priorities of people and groups operating in knowledge processes, allows the enablers to be aligned with them.

Flexibility in the configuration. If users' requirements are not perfectly known in advance, or if they change rapidly, flexibility of the system allows adaptation to new emerging priorities.

Coherence with organisational goals. A risk associated with the two previous principles is that of separation of the knowledge management system and the community (which has been fostered in this case) from the organisational goals. The knowledge management system in the action research case has demonstrated how the community priorities can be continuously combined with organisational priorities.

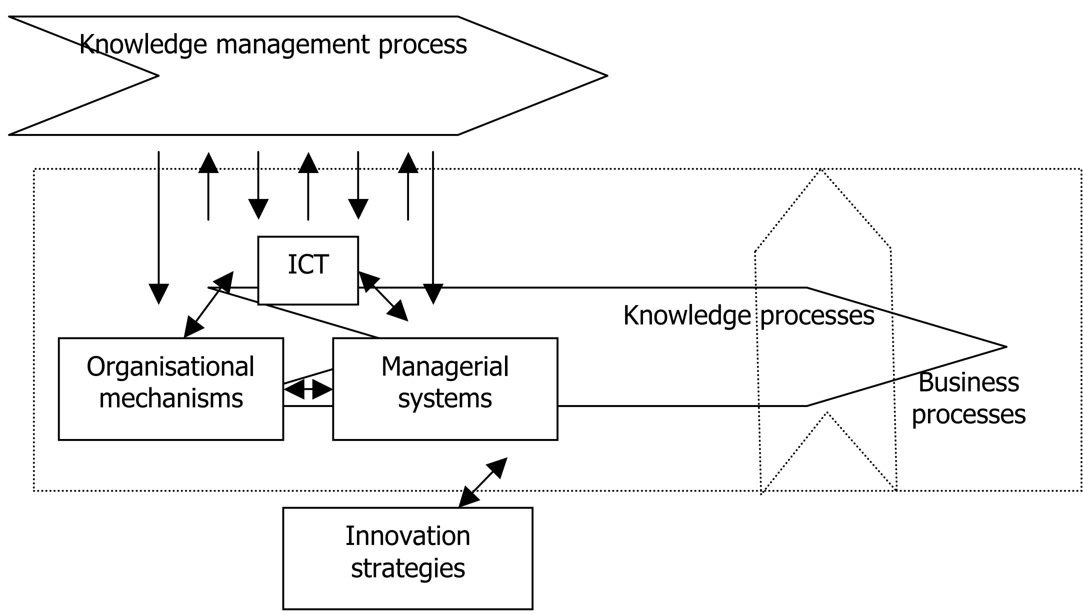


Figure 8.13: The role of the knowledge management process

- *Refinement of the model*. The main result, in terms of the model, concerns the identification of relationships among variables, which provides the possibility to develop new research propositions for further research. Two main categories of relationships emerge: internal relationships and external relationships.

  Internal relationships

  -*The role of ICT*. Within the configuration, ICT is only a means through which the community is supported. Its main goal, which is consolidated over time, is to recreate the context missing in the case of dispersed workers, by relying on functionalities that become richer over time.

The organisational mechanisms and managerial systems are continuously adapted to new emerging requirements (from both the community and company).

-*The relationship between the barriers and the enablers* implemented in the knowledge management system, as summarised in figure 8.14.

-*Other barriers have been identified* but not yet managed, so although the enablers and relative performances can be surmised from literature and previous research, they cannot be assessed as yet. These barriers are the number of members in the community, the diversity of the members, the integration of the community into the overall organisation, and the use of the knowledge management configuration to support both knowledge and business processes. The awareness of these barriers, and their relevance to the characteristics of the configuration, leads to some further research questions that could be addressed in later research (Chapter 9)

Barriers	***Enablers***	***Performances***
Familiarity with technology	Levers to assess the level of user unfamiliarity with the new functionalities, and to improve their technological skills	-Assimilation (B8) -Embedding into vehicles (B7) -Transfer within and among processes (B4 and B5) -Use of business activities to develop knowledge (B2)
The lack of slack for knowledge processes	ICT functionalities to facilitate the better organisation of business activities and the creation of slack. Organisational and managerial mechanisms to facilitate the identification of the real priorities for the users and to stimulate them to dedicate spare time to act in knowledge processes.	-Use of business activities to develop knowledge (B2) -Use of spare time to generate knowledge (B3)
The potential competition among users	No hierarchical formal mechanism between the community and the company (organisational mechanisms). ICT and managerial mechanisms to create an alternative neutral field of competition.	-Transfer within and among processes (B4 and B5) -Embedment into vehicles (B7)
The lack of commitment and sponsorship	Senior levels in the hierarchy do not play formal control, but support the development of competencies. Gradual involvement.	-Alignment with strategic goals (B1) -Abstraction and generalization (B6)

Figure 8.14: The barriers to change and the enablers to overcome them

-*Emphasis on performance measurement*: performances can be related to business processes, but also to knowledge processes. The emphasis on performance measurement is an effect of the principle "identifying people priorities". The identification and implementation of metrics to monitor people acting in a knowledge management system is a very strong lever to foster their participation, especially if aligned with the identified priorities.

-*Acquisition of generalised knowledge, stored at a tacit level*. If a decentralised approach, two modes of acquiring tacit knowledge stored tacitly have emerged: either contacting experts who store generalised knowledge, or acquiring explicit knowledge about motivations and, by using it, generalise knowledge based on experiences, even at a tacit level.

External relationships

-*Relationship with innovation strategies*. The innovation strategy is not only a contingent variable that influences the performances of a knowledge management configuration; it is also influenced by the choice of a knowledge management configuration. In other words, the innovation strategy is also a dependent variable in the sense that the adoption of an innovation strategy can drive the refocusing of strategic priorities.

A final note concerns the type of insights that are derived from action research. The propositions developed through action research aim to understand the main characteristics of configurational change, its process, and its effects on performances. Within action research, several methodologies can be used: in this case several qualitative research methods and a short survey (addressing especially people performances) have been adopted. The propositions, due to the explorative aim of the research question they address, can be a valid starting point for developing hypotheses to test also through quantitative research: for example, ones concerning the effects of the configuration on knowledge processes performances or people performances in specific contingent situations (determined for example by sets of contingent variables) (see Chapter 9 for more detail).

CHAPTER NINE:
IMPLICATIONS OF FINDINGS FOR THEORY AND PRACTICE

9.1 INTRODUCTION

The goal of the research developed in this thesis has been to gain insights into how organisations enable knowledge processes in innovative environments. Results from theory and earlier research (CIMA project and Gieskes, 2001) have been confirmed, operationalised, refined, and extended.

Theoretical contributions agree that knowledge management of intellectual capital has become a central theme in today's business environment and a commonly cited source of competitive advantage (Garvin, 1997, Drucker 1999). Three trends in today's business especially drive the interest in knowledge: globalisation and enlarged competition (Corso et al. 2002), the emergence of new organisational models (Drucker, 1999), and availability of new ICT technologies (Zack, 1999). In order to understand how to leverage on knowledge in order to exploit this advantage, a number of issues have been advanced as a starting point for this thesis:

- The definition of knowledge, knowledge processes, and knowledge management. The concept of knowledge is very complex, and it has been approached from several points of view in literature: organisational learning, innovation management, strategic management, knowledge management and ICT management. All these streams provide their own interpretation of knowledge and knowledge (management) processes.
- The analysis of how organisations foster knowledge processes. Early research analysed how companies can foster knowledge processes (with specific reference to learning processes in product innovation). In particular, a preliminary framework has been developed and refined in terms of: performances, representing the effectiveness of the organisation in stimulating and sustaining learning; learning behaviours, which are the combination, at the organisational level, of behaviours of individuals and groups concerning knowledge generation and transfer; levers, which are the actions and decisions that managers implement in order to sustain behaviours; and finally contingencies, which are the external variables influencing the system. This framework has been preliminary operationalised through ten in depth case studies developed in Europe and Australia, and then further applied in 70 companies. Elaborating, though statistical analysis, the data collected from this exercise, the model has been refined in order to derive the main levers that stimulate learning behaviours and which are the main barriers to learning.

Three research questions (with a number of subquestions) have been addressed in this thesis:

RQ 1: *What knowledge management configurations of ICT, organisational mechanisms, and management systems emerge in knowledge intensive, innovative environments, and which performances are related to them?*

RQ1.1. Which are the *functionalities of levers* fostering knowledge processes?

RQ1.2. Which *KM configurations* (in terms of ICT, organisation and management tools) are successful in terms of performances of the knowledge process?

RQ1.3. What are the effects of each *KM configuration of levers on performance?*

RQ1.4. Which *types of managed knowledge* characterise each configuration*?*

RQ1.5. Are the configurations of levers adopted in consultancy companies also valid in other knowledge-intensive industries?

RQ2: Is a particular KM configuration aligned with a specific innovation strategy?

RQ2.1 Is a KM configuration associated with a specific innovation strategy?

RQ2.2 Does an innovation strategy influence the success of a knowledge management configuration? configuration?

RQ3: How do changes in the configuration of ICT, organisational mechanisms and management systems support a company's knowledge processes and performances in situations where ICT has been the trigger of this change?

RQ3.1: what changes to the overall knowledge management configuration are stimulated by the change to one of the levers (i.e ICT functionalities)?

RQ3.2 what are the effects of configurational change on performances?

RQ3.3 what barriers to change and its effectiveness emerge?

RQ3.4 does the configurational change influence the innovation strategies adopted by a company?

This chapter reflects on the overall process in order to answer the three research questions and to discuss the results obtained from the analysis (Section 9.2), the overall methodology (Section 9.3), the contributions of the research to theory and practice (Section 9.4), and possible evolutions of the research (Section 9.5).

9.2 REFLECTION ON THE RESEARCH QUESTIONS

The points of departure of this thesis were twofold: theory, and results from earlier research. Firstly, theory from several streams has contributed to the topic of knowledge management:

- A multidimensional definition of knowledge, highlighting its peculiarities and challenges to be managed within an organisation.
- A model of the knowledge process based on the following phases: acquisition, capitalisation and reuse, transfer and sharing of knowledge.
- The identification of critical issues that enhance knowledge processes in innovative contexts: abstraction and generalisation, double loop learning, experimentation, and unlearning.
- The classification of types of knowledge according to the level of explication of knowledge, the knowledge object, and the level of abstraction and generalisation.

- A categorisation of levers of learning in terms of ICT, management systems, and organisational mechanisms.
- A classification of innovation strategies according to the degree of innovation (exploitation vs. exploration strategies), and to the main source of innovation (only internal vs. internal plus external).

Results relevant for this thesis, drawn from the CIMA project and Gieskes (2001) can be summarised in:

- A categorisation of eight learning behaviours that are associated to knowledge subprocesses. The frequency of these behaviours is assumed to measure effectiveness of levers on knowledge processes.
- Eleven categories of levers to stimulate learning behaviours and whose effectiveness has been measured (Some levers derive from the CIMA project, others have been renamed or emerged from the analysis of data).
- Eight contingency factors that were considered to impact on the above elements.
- Three classes of performances: improvement performances, people performances and business performances.
- The existence of barriers that hinder learning behaviours, which needed further investigation.

Starting from these points of departure, the research questions are reflected on below.

9.2.1 RQ1: The identification of KM configurations

Two main goals are associated with the first research question: firstly, to operationalise the conceptual framework of knowledge processes in innovative environments and, then, to determine whether configurations of levers that present similar functionalities, and implemented by companies in order to foster knowledge processes, demonstrate similar characteristics and performances.

Analysis was first carried out in successful consultancy companies (the research setting was chosen in order to focus on successful configurations) and in companies where knowledge management practices are reasonably consolidated. Results from this investigation provided an operationalisation of the framework:

1. *Levers*. In terms of the functionalities of ICT, companies implement tools to foster *knowledge transfer and sharing* (in terms of collaboration and/or communication) and *storage and retrieval* (for storing solutions and/or for storing standardised practices). Turning to Management systems, organisations adopt methodologies (i.e. after action review, peer assist, case based reasoning, learning history, incentives, brainstorming, meetings, yellow pages, best practices, training courses…) for *analysis*, *standardisation*, *performance measurement*, *job rotation,* and *training and mentoring*. Finally, in terms of organisational mechanisms, managers implement structures and roles (i.e. specialist unit for knowledge management, chief knowledge officer, responsibility of partners…) in order to *standardise practices*, to *diffuse responsibility* or to *own KM at a managerial level*. Different categories of levers are used for the various functionalities. To realise the desired functionalities of the levers implemented, several different solutions have been adopted by the companies.

2. *Performances*. Starting from the preliminary framework based on previous research work, the performances have been modelled in terms of knowledge process performances (operationalised through frequency of learning behaviours), people performances (in terms of better use of time, work satisfaction, self esteem, sense of belonging, reduction of labour turnover) and business performances (time to market, efficiency, customisation and customer satisfaction, lesser spin-off risks). It was concluded from the case studies that the different dimensions of performances are associated to the different configurations of levers.
3. *Contingencies*. Starting from the list of eight contingencies obtained from previous research work, three main variables were indicated as being relevant in managing knowledge processes: degree of dispersion, level of complexity of the solution and of the project (related to the type of consulting service provided-vertical integration), and finally the labour churn.

All the variables have been mapped in the sample through the use of an investigation questionnaire compiled by the researcher together with managers. Though an analysis of the similar functionalities of the implemented levers, three configurations emerged and, for each of them, the levers, performances, and types of knowledge managed were analysed. The contingencies will be further discussed when considering RQ2. The identified configurations were firstly labelled according to empirical findings and then they were embedded into theory. In more detail:

1. *Centralised approach (*empirically labelled as *Focus on standard KM practices).*
   - Organisation mechanisms stimulate the standardisation of KM practices. ICT supports the storing of solutions and procedures, and the asynchronous and distant communication. Management systems foster: the specialisation of people over time (i.e. no job rotation, career path…), the development of knowledge professionals as specialists, and the standardisation of knowledge practices (i.e. procedures).
   - Performances: if a company adopts a centralised approach, it is successful in terms of time to market, efficiency (business performances), high sense of belonging, and use of time (people performances). The most frequent behaviours are the embedding of knowledge into technological vehicles (B7), and the abstraction and generalisation of knowledge (B6).
   - The type of knowledge managed in this configuration is explicit and generalised knowledge about solutions and methodologies.

Explaining these outcomes though theory, it was concluded that the levers implemented in the centralised approach principally aim at *standardisation,* the effects of which can be recognised in the list of performances: knowledge processes are coordinated through the standardisation of work processes, and output is enhanced by the implementation of managerial mechanisms (through procedures and the development of specialist competencies) and stored and diffused throughout the organisation (though ICT). Centralising the responsibility for knowledge management in specialised units, and having a low horizontal decentralisation, also facilitate the standardisation of the process.

2. *Oligarchic approach (*empirically labelled as *Focus on Hierarchical KM practices).*

- Organisational mechanisms stimulate the direct supervision of the KM process in order to position ownership of the responsibility for KM at a management level. ICT supports the synchronous communication by managers, who often act in a virtual community, and asynchronous communication for workers. ICT is also used to make knowledge of workers explicit. The management systems foster assimilation of "lesson learnt" from workers but do not facilitate the development of specialised competencies in workers.
- Performances: if a company adopts an oligarchic approach, it is successful in terms of customisation and customer satisfaction, solution innovation, time to market (business performances), use of time, sense of belonging and work satisfaction (people performances). The most frequent behaviours are abstraction and generalisation (B6), and transfer of knowledge within and among processes (B4 and B5).
- The type of knowledge managed in this configuration is knowledge about solutions and methodologies in both tacit and explicit forms.

The characteristics of the oligarchic approach and its performances can be explained by considering that the implemented configuration aims at *keeping the responsibility of knowledge processes at a managerial level,* in order to innovate solutions and develop the relationship with customers at a managerial level, while maintaining standardisation and efficiency at the operative level. Direct supervision, and standardisation of work processes, are the key coordination mechanisms enhanced by the levers in this configuration (managerial mechanisms and ICT). Similarly, the organisation is characterised by low vertical decentralisation.

3. *Decentralised approach (*empirically labelled as *Focus on diffused KM practices).*
    - Organisational mechanisms stimulate the involvement of people throughout the organisation in knowledge management activities, while ICT mainly supports synchronous communication and collaboration. Managerial systems aim to make operational activities into opportunities to learn, providing occasions for learning during activities. People are evaluated and rewarded, to an extent, according to learning activities.
    - Performances: if a company adopts the decentralised approach, it is successful in terms of customisation and customer satisfaction, and solution innovation (business performances), work satisfaction, sense of belonging, self-esteem and reduction of labour turnover (people performance). The most frequent behaviours are seeing their activities as opportunities to develop knowledge (B2), and using spare time to generate knowledge (B3).
    - The type of knowledge managed in this configuration concerns solutions, methodologies, and issues in both tacit and explicit forms, and in both contingent and generalised forms.

The characteristics of the decentralised approach, and the effects on performances, can be explained by considering that all the functionalities of levers aim to *involve everyone in knowledge processes* in order to facilitate the generation of new ideas and self-esteem. The knowledge processes are coordinated through mutual adjustment and skill standardisation (which are fostered through managerial systems and ICT).

Similarly, this configuration is characterised by high horizontal and vertical decentralisation, since all people are expected to contribute to knowledge processes as well as to business processes.

All the characteristics of the configurations are summarised in figure 9.1: in terms of theoretical characteristics (Mintzberg, 1985), functionalities of implemented levers, and performances.

		Centralised approach	**Oligarchic approach**	**Decentralised approach**
Theoretical characteristics	*Horizontal decentralisation*	Low horizontal decentralisation Specialised units	Medium horizontal decentralisation Support staff	High horizontal decentralisation Widespread responsibility
	Vertical decentralisation	Medium vertical decentralisation	Low vertical decentralisation Hierarchical approach	High vertical decentralisation Cooperative
	Coordination mechanisms	Standardisation of work processes Standardisation of output Embedding of Knowledge through technical vehicles	Direct supervision Standardisation Of work Processes Embedding of knowledge through mixed vehicles Synchronous communication	Mutual adjustment Skill standardisation Embedding of knowledge through relational vehicles
Functionalities supported by levers	*Organisational mechanisms*	Standardisation of KM practices	Direct supervision of KM process. Keeping responsibility of knowledge processes at a managerial level	Involvement of all people throughout the organisation in knowledge management activities.
	Managerial systems	Specialisation of people over time Standardisation of knowledge practices	Analysis and standardisation	Performance measurement, job rotation, mentoring and training, job rotation
	ICT	Storing solutions and procedures Asynchronous and distant communication	Synchronous communication for managers and asynchronous communication for workers. Virtual community only for managers	Synchronous communication and collaboration
Performances	*Knowledge process performances*	Embedment of Knowledge in Technological Vehicles (B7) Abstraction And Generalisation of Knowledge (B6)	Abstraction and Generalisation (B6), Transfer of Knowledge Within And Among Processes (B4 And B5)	Business Activities are seen as opportunities to develop Knowledge (B2) Use of spare time to generate Knowledge (B3)
	People performances	Use of Time	Use of Time, Sense of Belonging, Work Satisfaction	Sense of belonging, Work Satisfaction, Self Esteem, Reduction of Labour Turnover
	Business performances	Time To Market, Efficiency	Customisation and Customer Satisfaction, Innovation in The Solution, Time To Market	Customisation and Customer Satisfaction, Innovation in the solution

Figure 9.1: The configurations for KM

The first analysis was carried out in the setting of the consultancy industry, which was extremely useful from the methodological point of view as knowledge management practices are reasonably consolidated (as knowledge is embedded in the core product/service). One goal was to see if the results would also be valid in other knowledge-intensive, professional companies. Therefore, two further case studies were developed in telecommunication industry, and it was found that the two companies implemented the centralised and decentralised approaches with good impacts on performances. Results showed that the implementation of the same functionalities of levers (as in the setting of the consultancy industry) fostered the same dimensions of performances and fostered the same types of knowledge in the new setting.

However, some of the characteristics in the configurations detected in the new setting could be explained by the specificity of the industry and the unit of analysis:

- Firstly, in professional knowledge-intensive organisations, if the scope of the knowledge management configuration is a functional unit, and the quality of its output is determined by knowledge; then the organisational, technological and managerial solutions at the company level, and the values and culture of the company, influence the choice of the functionalities of levers to be implemented to foster knowledge processes.
- Turning to the relationship between operational and knowledge processes: if knowledge is not the core output of the operational process, but it is embedded into products clearly determining their quality; then, the use of the same levers to support business and knowledge processes can be a constraint to knowledge activities in terms of time pressure and available slack. In this situation, the formalisation of the knowledge processes is important in terms of the definition of knowledge processes goals (explicit or implicit) and the control of knowledge processes performances.
- Finally, in professional knowledge-intensive organisations, unlike in consultancy companies, the level of consolidation of knowledge processes influences the choice of a knowledge management configuration.

Summarising, two main results have been derived from answering the first research question: a *framework*, confirmed and operationalised, about knowledge management in innovative, professional, knowledge-intensive organisations; and *three configurations of levers*, emerging from empirical analysis and embedded in theory, characterised by functionalities (and referred to forms), their impact on performances, and the type of knowledge supported.

9.2.2 RQ2: The role of innovation strategies for knowledge management

The refinement of the model is principally related to the internal configuration of levers and its impact on performances. It was not a goal of this thesis to develop a complete contingent analysis of knowledge management, taking into account all the CIMA contingencies. This analysis has been focused on only one variable: innovation strategies. The reason for this choice is twofold: firstly, because learning and knowledge process practices change completely when the level of innovation increases (Bartezzaghi et al. 1998; Hedberg, 1981; McKee, 1992). Secondly, because, during the case studies in the consultancy companies, managers indicated that the level of innovation embedded in the products/services offered is a critical variable in driving knowledge processes and the design of a knowledge management configuration.

Innovation strategies have been classified according to the degree of innovation. Companies primarily adopt an *exploration* strategy when they develop projects that include radical innovations (technological, market, or organisational). Companies pursue an *exploitation* strategy if they develop incremental innovations that tend to reinforce their competitive positions. Further, the innovation strategy of a company can be classified according to the source of the innovation. A company can rely on its internal sources of innovation, or it ca also leverage on external sources (suppliers, customers, competitors…).

Due to the specificity of the industry, the innovation strategies for consultancy companies were operationalised. Consultancy companies that deal with new problems, develop new (to them) solutions and highly customised solutions to unique problems, and focus on high profit margins, pursue an exploration strategy. Alternatively, consultancy companies can deal with problems by reusing past solutions, develop high quality, reliable, and fast implementations, and focus on revenues by pursuing an exploitation strategy.

The leverage on external sources of innovation has been operationalised through two types of variables: the involvement of universities and suppliers in the projects, and the involvement of the customer (which determines the type of role played by the consultant). Companies that implement expert consultancy models principally rely on internal sources of innovation without leveraging on the customer as a source of innovation (consultants are the main actors of the consultancy process in all its phases, and customers are not involved the in the development of the output). Companies implementing process models of consultancy involve external sources of innovation (consultants interact with other actors in order to develop the consultancy process and to innovate its output).

The analysis has been carried out in two steps:

1. Association between knowledge management configurations and innovation strategies in successful companies

Through the investigation of innovation strategies pursued by the consultancy companies, in adopting different configurations, it emerged that:

- All the consultancy companies rely on universities and suppliers as sources of innovation, since it is extremely important for them to improve their knowledge base: both explicit and generalised, as in the centralised approach, or tacit and at an individual level as in the decentralised approach.
- If consultancy companies implement knowledge management configurations that support the capitalisation and reuse of *existing generalised solutions and methodologies*, and pursue an exploitation strategy, then they are successful in terms of efficiency and revenues. Therefore, companies that implement a *centralised approach* to support acquisition, capitalisation/reuse, and transfer/sharing of knowledge, and pursue an exploitation strategy based on internal sources of innovation, are successful in terms of efficiency and revenues.
- If consultancy companies implement knowledge management configurations that support the acquisition, capitalisation and reuse, transfer and sharing of *new solutions and methodologies*, and pursue an exploration strategy, then they are successful in terms of innovativeness, customisation of solutions, and margins.
- In terms of exploration strategy, the generalisation of knowledge about solutions and methodology characterises the association between the knowledge management configuration and the innovation strategy (in terms of internal and external sources). If consultancy companies implement knowledge management configurations that support the *generalisation* of knowledge about solutions, (*oligarchic approach or decentralised approach*), and they adopt a strategy based on *internal sources of*

innovation (playing an expert role with the customer), then they are successful in terms of innovativeness, customisation of solutions and methodologies, and margins. However, if the knowledge management configuration does *not support the generalisation* of knowledge about solutions, but does support the development of *knowledge about methodologies and motivations* (*decentralised approach*), even in a contingent form, and the company adopts a strategy based on *external sources of innovation* (playing a process role with the customer), then it is successful in terms of business (innovativeness, customisation of solutions and methodologies and margins), people (sense of belonging, work satisfaction, self esteem and reduction of labour turnover) and knowledge performances (use of spare time to generate knowledge-B3, use of business activities as opportunities to generate knowledge-B2).

2. *Alignment of innovation strategies with the knowledge management configuration: through the analysis of poor performances and missing associations.*

Results from the analysis of consultancy companies reflect the association between innovation strategies and knowledge management configuration. In order to assess the alignment, the analysis has focused on knowledge management configurations that are characterised by poor performances, seeing if the reason resides in a missing association with innovation strategies. In order to develop this analysis, two case studies have been developed in two companies operating in the telecommunications industry. Through mapping the configurations and strategies of these companies, at several points in time, it was found that, due to a change in the innovation strategy, the configuration did not support the new requirements of the knowledge processes. In particular, it emerged that:

- If companies adopt a strategy based on the exploitation of solutions/methodologies and internal sources of innovation, a centralised approach that supports capitalisation and reuse is successful (in terms of effectiveness of retrieval and efficiency).
- If companies adopt an exploration strategy (in terms of solutions/methodologies), the decentralised approach that supports acquisition, transfer and sharing of knowledge is successful (in terms of acquisition, transfer and sharing of knowledge, quality of working life, and customisation and innovativeness of solutions provided).
- If a company pursues a strategy based on the involvement of relevant external sources of innovation, then a decentralised approach is effective in terms of generation of solutions, quality of working life, and innovativeness of the product.
- A final observation has been derived from the role of the functional unit considered in the overall innovation process (the unit of analysis in both companies): if a company has implemented a decentralised approach, every role in the product innovation process is a potential source of innovation.

The results concerning research question 2 are summarised in figure 9.2.

	Configuration→	*Centralised approach*	*Oligarchic approach*	*Decentralised approach*	
	Type of knowledge →			*Generalised.*	*Not generalised*
Relevant variables driving the alignment	*Innovation strategy*	Exploitation strategy Internal sources	Exploration strategy Internal sources	Exploration Internal sources	Exploration External sources
	Role of the consultant	Expert	Expert	Expert	Facilitator
	Output delivered to the customer	Existing solutions	New solutions and methodologies	New solutions, methodologies and scenarios	New solutions and methodologies
	Type of knowledge managed by the consultant	Generalised, explicit knowledge about solutions and methodologies	Generalised explicit knowledge about solutions and knowledge about methodologies (either contingent or generalised)	Generalised explicit knowledge about solutions; generalised knowledge about methodologies knowledge about motivations (either contingent or generalised)	Contingent explicit knowledge about solutions, methodologies and motivations
Effects on performances	*Business performances*	Time to market, efficiency revenues	Customisation and Customer satisfaction, Innovation in the solution, efficiency	Customisation and customer satisfaction, innovation in the solution	Customisation and customer satisfaction, innovation in the solution
	People performances	Use of time	Use of time, sense of belonging, work satisfaction	Sense of belonging, work satisfaction, self esteem, Reduction of labour turnover	Sense of belonging, work satisfaction, self esteem, reduction of labour turnover
	Knowledge process performances	Embedment of knowledge in technological vehicles (B7) Abstraction and generalisation of knowledge (B6)	Abstraction and generalisation (B6), transfer of knowledge within and among processes (B4 And B5)	Business activities are seen as opportunities to develop knowledge (B2) Use of spare time to generate knowledge (B3)	Business activities are seen as opportunities to develop knowledge (B2) Use of spare time to generate knowledge (B3)

Figure 9.2: The relationship between innovation strategies and knowledge management configurations

9.2.3 RQ3: The configurational change

The first two research questions explored the levers, contingencies (in terms of innovation strategies), and performances related to knowledge management. So far, only a few insights have been developed concerning the relationships among the variables. The investigation has concerned the configurations at specific moments in time. Even in the analysis of the two cases in the telecommunication industry, the analysis did not address the evolution of the configuration over time, and therefore no knowledge can be developed about the independent and dependent variables in the change. To rectify this, the investigation into configurational change has been designed as two steps:

1.preliminary investigation through longitudinal case studies

The companies in the telecommunication industry have been analysed over time, and any configurational changes (in terms of change in the functionalities of levers), the effects on performances, and the role of contingencies and the process of change (in terms of barriers) have been investigated. The focus was on configurational change triggered by a change in ICT functionalities. This was especially due to the increasing opportunities provided by ICT, whose contribution to knowledge management is addressed in different ways by literature: the technical approach emphasises ICT as the main lever for knowledge management, the socio-technical approach, on the other hand, states that ICT, to be effective on knowledge processes, has to be combined with organisational and managerial levers. In order to investigate the relationship between ICT and the other levers in the configuration, companies have been selected that were implementing new ICT functionalities to support knowledge processes.

From the analysis of the two case studies, the following observations can be made:

- Configurational change: if ICT functionalities are changed within the configuration, the other levers also change in order to support the overall configuration.
- Trigger: the configurational change is implemented in order to improve performances. Poor performances could be due to misalignment between the configuration and the innovation strategies.
- Barriers to change: include culture, values, and attitudes of people involved in knowledge processes, and the consolidated practices within the company. In particular, in the case studies, it emerged that the lack of familiarity with a technology, related to specific cultural attitudes of people, was not assessed when new ICT functionalities were introduced. The implementation of new ICT was not sufficient to enable the adoption of a new KM system by an organisation. A similar result concerns consolidated practices: if the new functionalities of levers implemented require a change also in consolidated practices, they are a barrier to change that hinder the adoption of the knowledge management configuration by the organisation. However, the longitudinal case studies enabled the existence of these barriers and their effects on performances to be investigated (they hindered the effects of the KM configuration on performances). Insight could not be derived about which levers could be adopted to overcome these barriers.
- The relationship between the operational process and knowledge process: if the knowledge management configuration does not explicitly stimulate people to carry out knowledge processes, then the stress on operational process goals and a lack of available slack are very strong barriers to knowledge processes. At the same time, if the stress on operational process goals is very strong, then the development of a knowledge management configuration relying on the same levers as adopted for operational processes, can help to overcome potential barriers to use of the system.

2. *Investigation through action research*

The propositions from the longitudinal case studies have been used to design the action research case, in terms of selection of the case (implementation of new ICT functionalities), and in terms of design of the process and the interaction with the managers in the company. As will be explained in Section 9.3, the challenge of action research is to shed more light on independent and dependent variables in configurational change through addressing, together with managers, some specific changes and monitoring their effects. The analysis has been carried out in Company K, operating in the telecommunications industry, and the analysis was focused on the implementation of a new ICT tool for the creation of a community of indirect salespeople operating in the B2B industry. The action research case enabled the analysis of:

- *The evolution of a knowledge management configuration*, starting from the implementation of a new ICT functionality. The configuration implemented was a decentralised approach, but the overall set of levers in the configuration changed over time resulting in the development of a community. From this it would appear that if ICT functionalities support synchronous communication and collaboration, and the adoption of specific incentives to stimulate people in sharing knowledge and solving each others' problems, that the configuration will be successful in terms of transfer of knowledge between and among processes (B4 and B5). From the analysis of the knowledge management systems, new requirements emerged about the functionalities of ICT from the users as well. Therefore, if the ICT structure allows flexibility (in terms of refining and adding new functionalities), and also the other levers can be adapted, then the overall configuration will evolve in order to include new requirements from people acting in the knowledge processes. The effects on performances (knowledge processes, people and then business performances) are extremely powerful. An interesting issue is that the functionalities of levers aimed at two goals: fostering knowledge processes, and managing and monitoring new requirements coming from the users of the system.
- *The development of the community.* Several contributions in the literature (Wenger and Snyder, 2000; Brown and Duguid, 1991) have discussed communities, but most of them concern the characteristics of communities and do not deal with the issue of creating a community. From the action research case, it was found that the implementation of a decentralised approach to knowledge management facilitates the creation of a community through building awareness of interests, practices, routines, and language. Moreover, by building integration mechanisms with the formal organisation, the knowledge management system facilitated the transfer of the organisation's strategic goals and objectives, and their use, within the community to focus and prioritise the improvement and learning activities.
- *The type of knowledge.* Analysing the types of knowledge fostered by the configurational change, several issues emerged. Firstly, through the use of ICT to communicate, incentives, performance measurement systems to foster joint solutions of problems, and the involvement of roles and training to support the understanding of motivations/issues, people will more frequently abstract and generalise knowledge and share it within the community. Moreover, providing explicit knowledge about motivations in a community supported by a decentralised approach can facilitate the generation of new tacit and generalised (causal) knowledge, deriving from the interpretation of experiences through these motivations. Therefore, in a decentralised approach, generalised knowledge can be acquired through contacting experts (as emerged from the case studies in the consultancy companies), or from facilitating the diffusion within the community of explicit issues and motivations which help people in developing generalised knowledge from their experiences.
- *The evolution of knowledge performances.* Knowledge performances change over time, according to new functionalities of levers implemented in the configuration. In the early phases, learning behaviours focus on the assimilation of knowledge; then they shift towards generation, transfer and sharing of knowledge; and finally to abstraction and generalisation. At the same time, self-esteem, due to improved business work, increases, as does the extent of collaboration within the community

(due to the focus of the configuration); and eventually a sense of belonging (due to the participation of managers of the company) and a reduction in staff turnover are fostered. A good knowledge process and good people performances have good effects on business performances. The real challenge in terms of this result is the enhancement of a virtuous cycle: business and people performances become a strong lever to stimulate people to participate in the community.

- *The barriers to change and effectiveness*: barriers to change that emerged from the action research case, concerned the level of familiarity of the users with ICT, the lack of slack for knowledge processes, the competition among users, and the lack of commitment and sponsorship. All these barriers have been identified by the companies and then managed in order to enhance the effectiveness of the change on performances. The types of functionalities of levers implemented in the configuration, in order to identify and manage those barriers, have been addressed.
- *Other barriers* have been identified, but not yet managed. These concern the number of people involved in the community, the typology of their background, the integration of the KM system with the overall KM configuration of the company, and the use of the functionalities of the configuration also for business processes. These are interesting issues on which to develop new research questions
- *The relationship with innovation strategies*: in the different stages of the evolution of the configuration, several opportunities to refocus the innovation strategies occurred: the adoption of a decentralised approach fosters an organisation in refocusing its strategy in terms of involvement of external sources of innovation.

Results concerning the third research question are summarised in figure 9.3, where the main variables in the preliminary model are represented and results are reported.

	Result	Description		
Role of the knowledge management	Levers to stimulate knowledge processes	If one of the levers changes, also the others change in order to develop a KM configuration.		
	Levers to design, maintain, improve and revise the levers; stimulating knowledge processes	A set of levers is implemented in order to overcome barriers to change and to monitor the evolution of the levers supporting knowledge processes		
	Principles driving the knowledge management process	-Identification of users requirements and priorities to design the configuration -Flexibility in the configuration -Coherence with organisational goals		
Refinement of the framework	***Internal relationships***			
	The role of ICT	In the decentralised approach, ICT recreates the context and does not stimulate the use of the KM system. The latter is the role of organisational mechanisms and managerial systems		
	The relationship between the barriers, enablers and performances	*Barriers*	*Levers to overcome barriers*	*Effects on performances*
		Familiarity with technology	Levers to assess the level of unfamiliarity with ICT and training .	Performance: -Assimilation (B8) -Embedment into vehicles (B7) -Transfer within among processes (B4 and B5) -Use of business activities to develop knowledge (B2)
		The potential competition among users	No hierarchical formal mechanism between the community and the company (organisational mechanisms). ICT and managerial mechanisms to create an alternative neutral field of competition.	-Transfer within and among processes (B4 and B5) -Embedment into vehicles (B7)
		The lack of commitment and sponsorship	No formal control. Gradual involvement of roles at high levels of hierarchy.	-Alignment with strategic goals (B1) -Abstraction and generalization (B6)
	Other barriers	-Number of members in the community -Diversity of members -Integration of the community in the overall organization -Use of the KM configuration for knowledge and business processes		
	Emphasis on performance measurement	Identify, measure and evaluate on the basis of knowledge processes performances is a strong lever		
	Acquisition of generalised knowledge, stored at a tacit level.	-Contacting experts who store generalized knowledge -Acquiring explicit knowledge about motivations and, thanks to it, generalizing knowledge based on experiences, even at a tacit level		
	External relationships	The adoption of a knowledge management configuration fosters the re-focalisation of innovation strategies		

Figure 9.3: Summary of results concerning RQ3

9.3 REFLECTION ON THE METHODOLOGY

Several methodological challenges have been encountered in this research work, and in the relationship with other research: the combination of the present research with other research works, the combination of different methodologies within this research work, and finally the combination of empirical and theoretical levels of analysis. In more detail, the methodologies adopted, and their focus, also considering previous research works, are summarised in figure 9.4.

Combination with other research works

As described in Chapter 4, the research carried out in this thesis has been combined with previous research. In the thesis, the combination of results of the different research works has been discussed. The other challenge that has to be considered concerns the combination of different methodologies to address the same research topic: the issue of relevant variables in the model of knowledge management. These methodologies are (see figure 9.4):

1. A preliminary explorative approach adopted during the CIMA project, primarily focused on learning in product innovation processes, in order to investigate all the possible levers that could be implemented within an organisation to foster learning (the list included 11 classes of levers), the behaviours (8 behaviours), performances (improvement performances, people and business performances) and contingencies (8 variables).

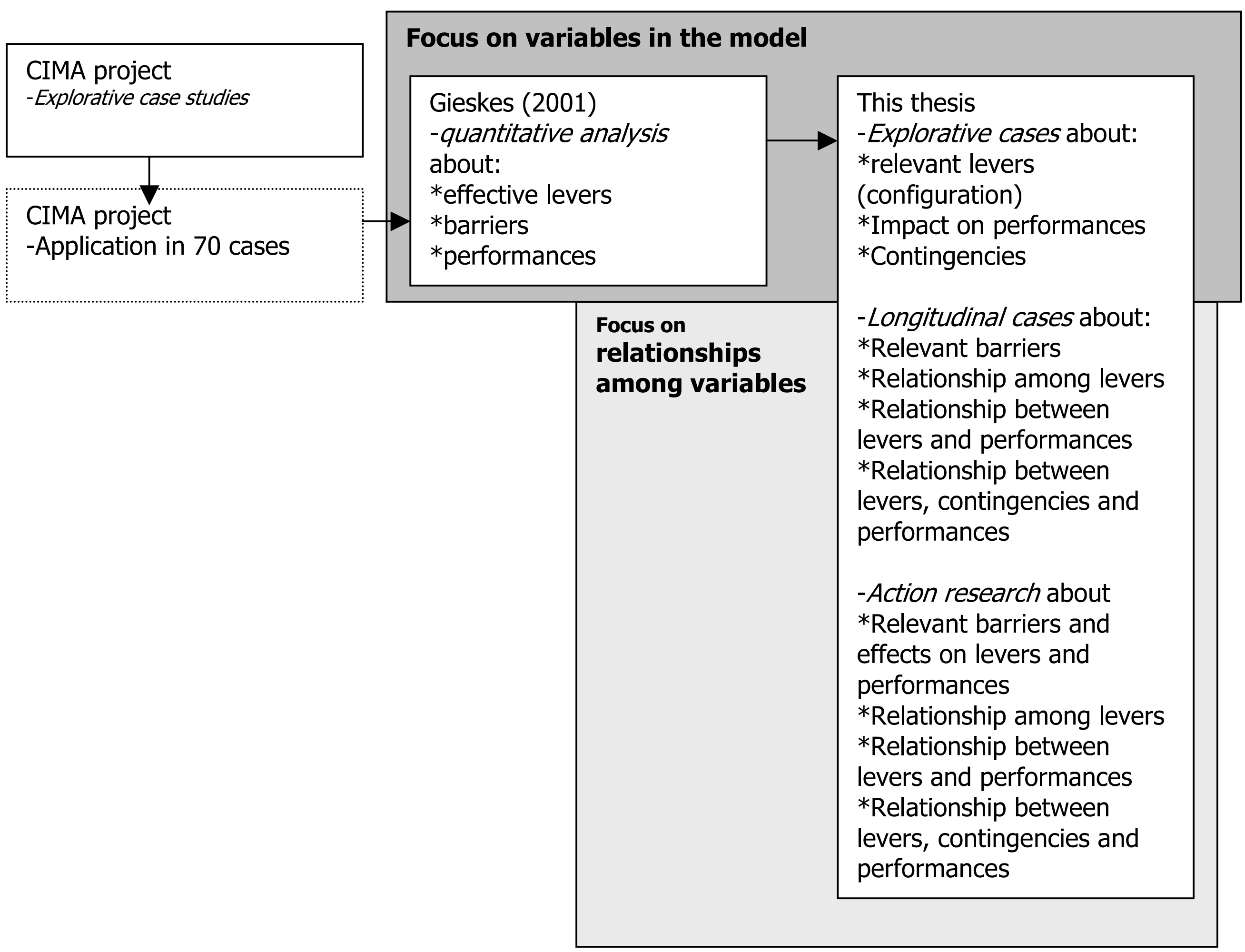


Figure 9.4: The relationships between methodologies adopted in this and previous research

2. The refinement of the preliminary framework through quantitative statistical analysis developed in Gieskes (2001). Through the research, additional insights have been developed on the relevant variables in the model, in terms of their impact on behaviours and barriers.

3. The exploration phase in this thesis started from the levers obtained from Gieskes (2001), and provided a confirmation of the earlier results, but at the same time, it moved the focus from the analysis of each lever in terms of behaviours/performances, to the analysis of the configuration of levers.

Considering the different research approaches, it is reasonable to conclude that a triangulation of methodologies has been achieved (Kekäle, 2001), thus providing a validation of the results. As the triangulation involved studies and analysis carried out in several pieces of research, by different researchers, it could be referred to as *external triangulation.*

Combination of different methodologies to operationalise and refine the model of knowledge management

The main goal of this thesis has been to *confirm*, *operationalise*, *refine* and *extend* the conceptual framework about knowledge management in innovative environments.

The *confirmation* of the model concerned the variables involved in the process, achieved through the preliminary investigation of knowledge (management) processes in the consultancy company industry. This analysis was also extremely useful in order to *operationalise* the model: the variables have been classified into categories, which could be assessed and measured. At this stage, a relevant assumption concerned the analysis of successful companies in terms of business performances: if companies are successful, and the knowledge process is their core activity, then knowledge processes must be managed successfully. Therefore, an analysis on the levers implemented by such companies would lead to the identification of successful configurations.

The *refinement* and *extension* of the model mainly concerned two issues: firstly, the existence of successful configurations of levers and, secondly, the relationship between the variables in the model (in terms of the association of configurations with innovation strategies, and in terms of change in the variables over time).

Within the thesis, in order to achieve these goals, several methodologies have been adopted: *multiple case* studies to operationalise the relevant variables in the model and to identify configurations, *longitudinal cases* for a preliminary analysis of the relationships among them, and *action research* to refine and extend the understanding of those relationships.

Several observations can be made about the adoption of the different methodologies in this research. Firstly, external triangulation, referred to work carried out in this thesis and in previous research works, has concerned the adoption of quantitative and qualitative methods to identify relevant variables. However, <u>triangulation</u> is also relevant in addressing the issue of *relationships among variables* in this thesis. The longitudinal case studies and action research both aim to investigate RQ3, concerning the analysis of configurational change. As triangulation is addressed within the research work, it is possible to refer to this as *internal triangulation*.

Moreover, one other reason driving the design of longitudinal case studies was to produce propositions for the action research. The <u>availability of preliminary propositions</u> at the beginning of the action research process allowed the approach to be focused on relevant variables in a context which otherwise would have been extremely difficult to manage: due to the number of roles involved, the scope of the project considered, and to the number of variables changing within the system.

At the same time, the potential of the action research approach, which differentiates it from longitudinal case studies, is the possibility of distinguishing the independent and dependent variables, through deliberately changing one of the variables in the system, and observing the effects on the others. This was not possible in the longitudinal case studies, where at each stage it was possible only to observe the overall change in a set of variables. A prerequisite for this task is the definition of preliminary propositions about variables, and hypotheses about the relationships among them (the output of the multiple and longitudinal case studies in the consulting and telecommunications industries). The intermediate theory developed at each stage of the action research allowed the preliminary propositions to be refined.

Another issue concerns the role of the researcher in the overall research: in the development of case studies, the researcher is mainly external to the system, and aims to interpret the system itself. The same role is played in the longitudinal case studies, where the observation moves to the evolution of the system over time. In the specific cases in this thesis, however, there was some involvement of the managers in the analysis, in order to get more detailed data about the company and to develop experience (on the research side) for carrying out the action research. During the action research, the researcher had to play a dual role: an interpretative role on what was happening in the case according to specific choices made and, at the same time, to act together with managers within the system, in order to understand all the effects on the variables in the system and refine the model.

A final reflection concerns the type of insights deriving from action research. Propositions developed through action research aim at gaining an understanding of the main characteristics of configurational change, its process, and its effects on performances. Within action research, several methodologies can be used: in this research, mostly qualitative methods and a short survey (addressing especially people performances) have been adopted. The propositions developed are a valid starting point for developing hypotheses to test through quantitative research.

Combination of empirical and theoretical levels of analysis

Another challenge concerned the combination of empirical and theoretical levels of analysis. As described in Chapter 4, the use of theory in this thesis is twofold: firstly, to develop preliminary theory to apply in an empirical setting; and then to explain and interpreting results, validating them and build new insights. It is important to note that empirical results have been:

- *Interpreted* through theory. This allowed the results to be explained, and then embedding in theory.
- *Validated in different research settings.* This is related to the generalisability of results.
- *Checked through several methodologies.* The internal and external triangulations allow the development of reliable results.

9.4 CONTRIBUTIONS OF THE RESEARCH

The aim of this section is to highlight the main contributions of this thesis to the development of theory and practice and then to derive some guidelines for designing further research (in Section 9.5).

9.4.1 Contribution to theory

The research interest of this thesis is *how knowledge processes can be supported in innovative and knowledge-intensive environments, with particular emphasis on the role of ICT*. The research especially focuses on managerial activities and decisions that help companies in stimulating knowledge processes; on how those decisions are related, with specific focus on ICT; and how they relate with the innovation strategy of the companies. The research is clearly rooted in different streams of literature: organisational learning, innovation management, strategic management, knowledge management and ICT management literature. All of them provide their own interpretation of knowledge and of knowledge processes. Further, a research work with a specific focus on product innovation has been carried out. Reviewing theory and previous research according to the research interest, the starting point for this thesis can be summarised as follows:

- A multidimensional definition of knowledge, highlighting its peculiarities and challenges to be managed within an organisation (Nonaka, 1991; Teece et.al, 1997).
- A model of the knowledge process based on its phases: acquisition, capitalisation and reuse, transfer and sharing of knowledge. Each phase is characterised by the participation of actors who can be internal and external to the organisation. The individuals and groups operating in the various phases show behaviours whose frequency reflects the extent to which they are involved in knowledge processes (Huber, 1991).
- The classification of types of knowledge according to the level of explicitness of knowledge (Polanyi, 1966; Nonaka and Takeuchi, 1995), the knowledge object (in terms of know what, know how and know why) (Quinn et al. 1996, b), and the level of abstraction and generalisation (knowledge can be contingent and generalised) (Bartezzaghi et al. 1997).
- The identification of all the possible levers (under different headings) fostering knowledge processes. These enablers have been systematised, and the effectiveness of each of them on knowledge processes has been assessed (Gieskes, 2001).
- A categorisation of levers of learning, in terms of ICT, management systems and organisational mechanisms (Zack, 1999a).
- The identification of critical issues for enhancing knowledge processes in innovative contexts: abstraction and generalisation, double loop learning, experimentation, and unlearning (Hedberg, 1981; Argyris and Schon, 1978).
- Innovation strategies can be classified according to the degree of innovation (exploitation vs. exploration strategies) and to the main source of innovation (only internal vs. internal plus external) (Zack, 1998).
- Barriers of learning are not the inverse of levers (Gieskes, 2001).

The contribution of this thesis is focused on understanding how knowledge processes take place in innovative organisations, and how managers can stimulate them. Although rooted in the streams of literature highlighted, such a contribution can be referred to the knowledge management topic.

The contribution of this research can be referred to as three groups of results: the first group (how organisations foster knowledge processes) addresses the types of approaches and their effects on performances. The other two groups refine the previous one in terms of the relationships among variables: the second group concerns the relationships among internal variables, while the third group concerns the relationship with external variables.

How organisations foster knowledge processes

- *Three configurations of levers* emerge from the analysis and are embedded in theory: the centralised, oligarchic and decentralised approaches. These are successful in their effects on knowledge processes, and they reflect characteristics emerging from theory concerning organisational design. In particular the three configurations are characterised by:
  - *Different functionalities of ICT, managerial systems and organisational mechanisms implemented to foster knowledge processes*. The levers can be operationalised according to their functionalities towards knowledge processes, and they can be shaped in different forms or solutions to realise the same functionality. Technological solutions realise ICT functionalities, managerial tools and methodologies realise managerial systems functionalities, and organisational structures and roles realise organisational mechanisms functionalities. Most if ICT management literature (Ruggles, 1997; Bradshaw et al. 1997) addressed the ICT functionalities (often focused on specific tools), without considering the management systems and organisational mechanisms that, implemented in the same KM configuration, foster their effectiveness on knowledge processes.
  - *Different performances* measured in terms of: frequency of learning behaviours of people and groups operating in knowledge processes, people performances, in terms of satisfaction of people in performing their work, and business performances. Few and only recent contributions in literature address the issue of performance of knowledge management (Germain et al. 2001), due to the difficulty in measuring the effects of the implemented enablers: it is topic of increasing interest.
  - *Different types of knowledge*. Each configuration supports different types of knowledge when considering the three classifications: according to the object, according to explicitness of knowledge, and according to the level of abstraction and generalisation of knowledge (Nonaka and Takeuchi, 1995). Although literature provides several frameworks for knowledge classifications (Quinn et al. 1996), most of them are theoretical and not based on empirical evidence. The approach adopted is in line with research works carried out at University of Twente (Wijnhoven, 2002) which aim at deriving consequences for knowledge transfer systems according to different types of knowledge.
- *In the decentralised approach*, functionalities of levers are implemented in order to:

- stimulate knowledge processes;
- overcome barriers to change and to monitor, improve and revise the levers implemented to stimulate knowledge processes. These levers pursue three principles: *identification and monitoring of users' priorities, enable flexibility, and create coherence with organisational goals*. This result is important in terms of understanding how the levers implemented in a decentralised approach work in order to reach good performances. This result is coherent with the "personalisation strategy" provided by Hansen et al. (1999).

- According to the scope of the knowledge management configuration (overall company/functional unit), the organisational structure, the technology, the management system, and the values at a company level become contingent variables that influence the design of the configuration implemented, and its effects on performances.

Internal relationship among variables

In order to understand how organisations foster knowledge processes, this group of results is focused on the identification of the relationships among the *variables within a configuration*:

- If ICT functionalities change within the configuration, then the other levers also change in order to support the overall characteristics of the configuration and to achieve successful performances. As already highlighted, ICT management literature (Stein and Zwass, 1995) is primarily focused on one single lever, without considering the relationship with other variables. Moreover, most contributions address knowledge management with a case study approach, and only few of them consider configurational change (Orlikowski and Hofman, 1997).
- *The role of ICT.* In a decentralised approach, ICT recreates the context of interaction among workers (Linger et al., 1999), but does not stimulate the use of the KM system. The latter is the role of organisational mechanisms and managerial systems. This is in line with the socio-technical approach to knowledge management (Carayannis, 1998).
- *Transfer of knowledge stored in tacit form*. In the decentralised approach, the acquisition of generalised (causal) tacit knowledge, stored at a tacit level, is fostered either through contacting experts who store generalised knowledge. This in line with the contribution of Hansen et al. (1999). In the research, however, it emerged that the acquisition of tacit knowledge, stored at a tacit level, can be stimulated also by acquiring explicit knowledge about motivations and, from this, generalising knowledge based on experiences, even at a tacit level.
- *Barriers to configurational change* are not the inverse of levers. Barriers concern the level of familiarity of the users with ICT, the lack of slack for knowledge processes, the competition among users, and the lack of commitment and sponsorship. An appropriate configuration can help the organisation to overcome these barriers. The configuration can implement specific functionalities of levers in order to overcome these barriers and enhance the effectiveness of the overall configuration. The specific effects of those barriers have been identified. This approach is complementary to the one provided by Kim (1993): according to this perspective barriers were

related to incomplete learning loops. However, the mechanisms determining these incomplete loops were not analysed.

- *The configurational change effects on different performances over time*, depending on the functionalities of levers implemented. The effects on business performances, and the awareness of the relationship between the performances and the use of the knowledge management configuration, become stronger levers. Performance measurement is therefore important to monitor the results achieved by the knowledge management system (Daft, 2001), but at the same time, it is also a real enabler of knowledge processes.
- *The creation of a community*. Few contributions have developed a theory about the process of creating a community, and most take it for granted that the main issue for managers is to capture knowledge from communities that already exist (Wenger and Snyder, 2000). The research has identified a new task for managers: to create the awareness of being part of a community.

External relationships among variables

- *The innovation strategy pursued at a company or functional level influences the design of the configuration implemented and its effect on performances*. Literature in the area of innovation and knowledge management highlighted how innovation influences the levers adopted by companies to foster knowledge processes (Bartezzaghi et a. 1997; McKee, 1992). Moreover they have stated that knowledge management in innovative environments is a real challenging task (Hedberg, 1981). This research explains the relationship between innovation strategies and knowledge management configurations in two directions: firstly, how innovation strategy influences the choice of a knowledge management configuration in line with the approach followed by Zack (1999b). In particular, if the focus of the company is on reusing solutions, and it adopts an exploitation strategy, it is successful. Moreover, if the knowledge management configuration supports the generalisation of solutions, then the source of knowledge is mainly internal. If it does not generalise solutions, a process model of consultation is followed, and the real support provided consists of knowledge about methodologies and motivations. Secondly, the adoption of a specific knowledge management configuration can foster the organisation in pursuing a new innovation strategy: the adoption of a decentralised approach can involve new actors in the innovation process, and therefore change the innovation strategy of a company.

9.4.2 Contribution to practice

This thesis does not contain guidelines for managers, but its main findings contribute in supporting the decision process of managers.

In the last decade, leading companies, primarily in the professional service industry, have structured knowledge management as a distinct and explicit process reshaping their organisational and management structure. According to the Gartner Group, 90% of the US and European companies have launched initiatives to share their ideas and best practices (Harris and Berg, 2002). Well-known players like Motorola, General Electric, Accenture, Buckman Laboratories, Chevron, Daimler-Chrysler, Dow Chemical, Ford, Hoffman

LaRoche, McKinsey & Co., Microsoft, Novartis, PriceWaterhouseCoopers, Siemens, and Texas Instruments have developed leading approaches to Knowledge Management claiming enormous benefits from their initiatives. Ford estimated that they had saved 914 millions $ due to KM initiatives in the period 1997-1999. In the same period, Chevron estimated 650 millions $, and Texas Instruments 1 billion, in savings from the formal sharing of best practices (Cainarca et al. 2002).

However, research carried out by PriceWaterhouseCooper shows that less then 10% of the surveyed CEOs are satisfied with the results of their KM efforts (Kelleher and Levene, 2001). There are still enormous opportunities to improve the effectiveness of Knowledge Management: according to *International Data Corporation,* in the first 500 Fortune companies, 12 billions dollars are lost in productivity each year due to poor Knowledge Management practices.

The managerial challenge is real: to create a sustainable work organisation, or configuration of organisational mechanisms, ICT, and management systems that will enable, at the same time, efficiency, innovation, and good quality of working life.

Two main contributions are addressed in this thesis: first of all the adoption of a methodology that allows the viewpoint of managers to be included, and, then the development of results that are useful for managers.

- *Methodology*: as described in Section 9.3, the methodology adopted in this thesis is strongly based on the contributions of managers. In the case study research, they were primarily interviewed in order to explore practices but, since the longitudinal case studies, they have been more involved with an active role. Especially in the action research phase, discussions with managers were carried out in order to check the variables in the model, the meanings given by the researcher, and the relationships derived from previous stages of the research. This provided the opportunity to refine the model in order to developed "actionable" knowledge: knowledge that could be also used by managers when carrying out KM projects.
- Results, four main results have been seen as relevant by managers:
  - The *reference knowledge management configurations*. The companies in this study initially started by implementing an ICT tool, without considering the relationship with other variables (within the configuration, and externally with the innovation strategy) and this resulted in poor performances. Once they also adopted organisational mechanisms and managerial systems, their performances improved. The option of having reference configurations is very useful for managers since it enables them to start their projects with a preliminary reference model.
  - The *barriers*. From the cases, it was seen that a lack of identification and management of barriers leads to unsuccessful knowledge management configurations. Barriers were either related to change (i.e. to inertia and to low familiarity with ICT tools), or related to the effectiveness of levers on performances (i.e. potential competition and lack of slack). From the study, it emerged that, in the companies that did not recognise such barriers, behaviours were not frequent. Those companies, that did identify the barriers, and

implemented levers to overcome them, saw positive effects on behaviours. The awareness of barriers, and of possible levers to overcome them, can help managers in creating a monitoring system.

- *The process*. This issue is a relevant topic for new research. The development of knowledge management systems has traditionally been assimilated as a part of a management task (Davenport et al., 1998; Quinn et al. 1996). However, from the action research case, it would seem that one of the keys to success is the flexibility of the system in terms of its ability to perceive users' new requirements and to adapt the system accordingly. This could be a successful approach to the implementation of a new KM system.
- The *performances*. The issue of performances was extremely important in the action research: in investigating the evolution of variables in the system according to preliminary hypotheses. From a managerial point of view, they are a useful tool for monitoring the implementation process and eventually refining the actions taken.

9.5 NOTES FOR FURTHER RESEARCH

From the results, several propositions have been made which are important in the design of further research. In particular they can be further refined or they could lead to further hypotheses to test.

The present research aimed to confirm, operationalise, refine, and extend a preliminary conceptual model on knowledge (processes) in innovative environments. The analysis of variables, and their relationships, has been carried out primarily using qualitative methods (multiple cases and longitudinal cases). The action research also relied mostly on qualitative methods. New research questions emerged, triggered by two issues:

1. From *the type of insights derived from the methodology* adopted in this thesis. Multiple cases allowed knowledge to be developed that has been explained through theory. Action research aimed to gain an understanding of the relationships among the variables, generating preliminary theory that could be tested at each stage of the investigation. The propositions in this thesis can be considered as a valid starting point for developing hypotheses to test through quantitative research. Among the propositions, the ones which rely on results either embedded in theory or derived from triangulation (internal or external), can be considered as most promising in terms of testable hypotheses.
2. From the *results from action research* that could not be further investigated due to the context of the specific case and the time limitations of the research. The results relate to the decentralised approach, and further research could investigate the same processes in centralised and oligarchic approaches. Further research could consider the issues of the development of a community, and the process of implementing a new knowledge management configuration.

The research questions which seem to be the most prominent, considering the results and the newness of the topic, are:

- *How can the process of implementing a new knowledge management configuration be organised and managed?* Very few contributions in the literature address the issue of implementing a new knowledge management system in an empirical setting (Davenport et al. 1998), and the few that do mainly address it according to a "change management approach". Answering this new research question could benefit of the understanding of the variables that determine the success of the knowledge (management) processes, and the classification of the configurations, which are a result of this thesis. In the current research, several principles driving the success of the implementation of a decentralised approach have been described, but insights have not been developed with regard to centralised and oligarchic approaches. The proposed research question could be addressed through an explorative analysis, investigating, using a retrospective approach, companies where KM configurations have been implemented. The analysis could concern the process (in terms of goals, roles, phases, and possible evolutions) according to the type of configuration adopted, and taking into account the success of the implementation process. The question aims at classifying the types of implementation processes that could be adopted in the case of different configurations.

  The proposition from this thesis, to be refined in future research, is:

In the decentralised approach, if ICT is flexible (in terms of refining and adding new functionalities in order to include the new requirements from people acting in the knowledge processes), and also the other levers can be adapted according to them, then the decentralised approach is successful in terms of generation of knowledge (B2 and B3), and in terms recognition of role and work satisfaction.[5]

- *How does the knowledge management configuration evolve over time? Which are the triggers of this evolution? Are there maturity levels in this evolution and which functionalities of levers characterise them*? The case studies developed in the consultancy companies concerned successful configurations in an industry where KM practices were already consolidated, and there was a high level of awareness of the importance of KM. The action research case, however, involved a company addressing KM issues for the first time. In considering the community involved, it is clear that barriers to including it within the knowledge processes of the organisation are now emerging. The proposed research question addresses how a knowledge management system evolves over time, considering the particular situation of a community. A number of subquestions arises:
  - How does the number and composition of the community influence its effectiveness in terms of knowledge processes performances within the community and towards the company?
  - How can the potential knowledge of a community be exploited without denaturing the characteristics that drive its success?
  - Can a knowledge management system that fosters the knowledge processes in a community also enhance business processes?

  The research question is relevant for two reasons: firstly, because answering it means to identify the key decisions that could be taken to improve the system and its performances over time,

[5] The proposition has been addressed in chapter 8 as RQ3.9

contributing to develop a form of improvement model for the development of knowledge management configurations. Further, in this research work it has been shown that a decentralised approach supports the creation of a community; if also the new research question was focused on a decentralised approach, then more insights could be provided about the evolution of communities within the organisations, which is a really unexplored and challenging topic.

This research question could be addressed through two action research projects, possibly starting with the implementation of two different configurations, and extended over a longer time than the research reported here. One could analyse how the configurations change according to external variables, how they trigger other changes within the considered functional units and in the organisation (in terms of new goals and priorities), and reflecting new knowledge processes priorities due to a higher level of maturity of the KM configuration. Related to these two issues, some propositions highlighted in the research seem extremely interesting in terms of developing new research questions.

If the decentralised approach fosters the creation of a community, and it creates the awareness of the community itself in terms of interests, practices, routines and language; then the members of the community start to use business activities as opportunities to develop knowledge (B2), to transfer knowledge among different processes (B5), and embed knowledge into vehicles (B6). At the same time, they reduce the frequency of assimilating knowledge from external sources (B8).[6]

The diversity of members in a community is a barrier: potentially they have to share the same interests, language and priorities, in order to enhance the effects of levers on performances.[7]

The integration of the community in the overall organisation is a strong barrier to the effectiveness of the levers on performances. If the priorities and the structure of the organisation, the ICT functionalities, the performance measurement, and the reward systems already available in the company and in the community are not consistent, then the decentralised approach to supporting the community is not effective in terms of transfer and sharing of knowledge (B4 and B5).[8]

The use of a knowledge management configuration to support both knowledge and business processes facilitates to capture knowledge embedded in business processes and creates more slack in business processes. At the same time, it hinders certain functionalities of the implemented levers: the creation of a neutral arena for competition/game playing, and working without a hierarchical component.[9]

[6] The proposition has been addressed in chapter 8 as RQ3.12
[7] The proposition has been addressed in chapter 8 as RQ3.26
[8] The proposition has been addressed in chapter 8 as RQ3.27
[9] The proposition has been addressed in chapter 8 as RQ3.28

- *What configurations are implemented in different contingent situations and what are their effects on performances*? Starting from the propositions about the configurations[10], and from the refined list of contingencies, a quantitative analysis can be developed, involving a sample of companies and mapping their configurations, their contingent situation, and their performances. Additional insights can be developed on effectiveness of configurations, and more normative knowledge can be derived. This research question would add value for the propositions concerning the configurations that have been embedded in theory.

The setting and unit of analysis for the above three research questions would depend on the scope of the knowledge management configuration. If the knowledge management configuration is developed to enhance knowledge processes within a functional unit, it is necessary to evaluate how it contributes to refocusing the overall strategy and organisation of the company as a whole. However, in order to reduce the complexity of the analysis, all the case studies involved should have similar scopes in their configurations.

It is interesting to note that the second proposed research question relies on multiple methodologies: action research that can be based in the different stages, and on qualitative and quantitative methods to gather data. The latter could be extremely useful especially in order to investigate the effects of the configuration on the different roles in an organisation at the different stages during the analysis. This could also provide opportunities for internal triangulation.

9.6 A FINAL COMMENT

The word "management" derives from the Latin "Manus" (Hand). It is a very concrete concept related to how a task or a phenomenon can be modified and forced in order to reach the desired results. Knowledge management is a really complex issue; how to manage something that is like air: ubiquitous, invisible, and taken for granted. It firstly requires to understand of what knowledge is, and then to determine how it can be fostered. This is the perspective taken by "organisational learning literature" which can be considered as the fundamental basis for every research work on knowledge management. Starting from this point, this thesis has addressed the issue by relying on an inductive approach: reasoning from specific experiences to general truths (Kekäle, 2001). Beyond all the specific results already pointed out in the thesis, several issues emerged:

- *There is not one only way to manage knowledge*. Starting from the concept of knowledge, does not explain why companies adopt different approaches to how it can be managed, all of which can be very successful. The approaches are related to the innovation strategy adopted, and more generally to the contingent situation in which the company operates. These approaches are described in terms of "levers" (the "manus")- the decisions that influence the system and its performances. All the approaches (three emerged from the investigations) reflect a set of functionalities (of ICT, managerial systems, and organisational mechanisms) which are *consistent* in the sense that if they are all present, the performances are successful, if one of them changes, all the others change in order to influence performances.

[10] All the propositions addressing RQ1

- *Knowledge management is a process of designing, monitoring and revising the "levers"*. As the system evolves over time, there is a double level of "management" control: the levers that stimulate knowledge and knowledge processes, and the levers that monitor and revise this system of levers. From the analysis carried out on a specific configuration, it emerged that the fundamental prerequisites are an adherence with users' requirements, flexibility, and coherence with organisational goals. However, other prerequisites could easily emerge for other configurations. The essential issue to enhance "control" is the assessment of performances at the knowledge process, people and business level. Moreover, the second level of "control" is also responsible for the identification of possible barriers: barriers to knowledge processes are not the inverse of levers (Gieskes, 2001), and they have to be identified and overcome in order to allow the levers on performances to be effective.
- *The configuration used by an organisation to stimulate knowledge processes, also influences the innovation strategies*. The contingency theory does not completely fit with the issue of knowledge management. The innovation strategy influences the performances of knowledge management configurations, but at the same time, the potentialities, in terms of knowledge processes enhanced by the KM configurations, influence the map of possible sources of innovation within and among companies. The design of a knowledge management system should therefore consider the roles of employees in the innovation processes.

Addressing the topic of knowledge management through an inductive approach requires keeping two issues in mind: the scope of the investigation, and the type of variables that have to be assessed and measured. Limiting the investigation to ICT implementation is extremely reductive: from this research it has emerged that many variables, also related to managerial choices and strategies, are influenced by the KM approach. Moreover, addressing this topic involves having to deal with intangible variables such as "culture", "behaviours", and "attitudes" which are extremely difficult to operationalise and especially hard to manage. This raises the issue of the choice of methodology: the development of a quantitative methodology should benefit from a preliminary understanding of relevant variables.

A final note: although focused on "management", the results of the research are not only for managers. They are first of all for researchers, in order to provide more insights into an issue that is widely recognised as relevant but rarely investigated in "managerial" terms. They are indeed also for managers, to provide a greater understanding of the scope and variables to be considered when a knowledge management configuration is being developed. Finally, they are for knowledge-intensive workers, to provide evidence that "knowledge is an asset" and that many organisations are nowadays trying to develop knowledge management approaches that will also improve the quality of their working life.

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APPENDIXES

APPENDIX I: ICT TECHNOLOGIES

The main goal of this appendix is to list the main ICT technologies highlighted in literature and provide a brief description of them

Technology	Description	Examples/References
Intranet	It is the perfect environment for sharing of knowledge as it is dynamics and supported by links. The main problem related to Intranet is "information pollution" which is the same problem as Internet environment. On the Intranet lots of content are available, but nobody knows how to find the real interesting issue. Usually the Intranet network is divided into two areas: The web browser, IP networks, the thin servers and the HTML which constitute the technological infrastructure The web server which is used as repository It is important to highlight that accessing the Intranet does not mean accessing all the contents available within the company. Other specific applications and repositories exist beyond the web server.	PriceWaterhouseCoopers Centre, 2000
Electronic Document management systems	They are sources of important documents and so they are sources of explicit knowledge. They are both repositories of documents but also they include tools for generation and editing of new documents. Usually EDMS (electronic document management systems) concern capturing, managing, routing, storing and sharing of electronic documents. In those documents images, audio and video files can be included. Main categories of EDMS are: *Document management* *Imaging* *Workflow*	PriceWaterhouseCoopers Centre, 2000

Document management	Document management tools provide the capability to organise and maintain the integrity of unstructured and semistructured data in documents. The main mechanism to manage documents is to create structure in the form of information about the documents' attributes (metadata) typically stored in the underlying database. So, documents can be searched for, retrieved, and managed based on a combination of the metadata fields and full-content indexing. The functionalities of a document management system can be classified according to the life-cycle of a document (which is concidered as paper or electronic document): *Creation* of a document: this process refers to the ability of creating a new document with a specific standard in terms of fields, necessary or optional information, length or format. *Modification* of a document: this process maintains the integrity of documents as they are being edited, often by several authors. One method is version control (tracking the versions of documents over time) to allow rollback. Another one is tracking when and by whom every change was made. *Security* of documents: access restrictions ensure that only those who have permission can access or modify the documents. *Approval* of documents: this functionality route documents through multiple levels of approval. *Distribution* (publishing) of documents: this process makes the document available to its various audiences electronically or on paper. *Archiving* of documents: the retention of documents is a very important task, as it requires the choice of the media and of the number of versions developed. In some document management systems some other functionalities can be provided: search and retrieval, version control and check is/check out facilities, document tracking, document organisation and document routing. Therefore it is possible to distinguish passive content repositories from active repositories which essentially push content to users.	PriceWaterhouseCoopers Centre, 2000
Imaging	The Imaging system converts paper documents into electronic files, enhancing the possibility of capturing, storing and archiving document images. The standard format is TIFF (tagged image file format), and in the last years PDF (portable document format) format has become the most popular.	PriceWaterhouseCoopers Centre, 2000

Workflow	Workflow is the automation of business processes, managing the movement of information as it flows through the sequence of steps that make up the work procedure by maintaining a record of changes in status and the state of document or transaction. The workflow defines all the steps in the process from start to finish including all the exception conditions based on established business rules. Two categories of workflow applications can be defined: *Collaborative workflow*: they aim at creating a collaborative environment between knowledge workers located in different units. *Production workflow*: they aim at managing the single transaction. They are usually centered in a single unit and aim at providing all the information or document necessary to manage the transaction. Therefore they rely on document image storage, retrieving capabilities, intelligent forms, database access. In order to implement a workflow, it is necessary to analyse the processes the company wants to automate, the policies which officially define how the process is managed and finally practices which determine how policies are implemented. Finally in order todefine a workflow application using a workflow product the organisation must specify all the routes of information throughout the process, rules and decisions that determine the process and roles played in the process. Concerning the workflow architectures, basicly two workflow applications exist: messaging based (also called email based) and database based. Messaging based workflow send assignments through email systems reaching good performance in terms of distribution. Nevertheless multiple copies of information are created when work is routed in a parallel fashion and moreover, while employees are working on an assignment, the system cannot see the document. In the database centered system the work resides centrally and it is much easier to manage. All people can have access to the appropriate server and remain online while participating in the workflow. Finally web based workflow combines the benefits of both architectures: the information resides in the database on the server and work assignments are rendered dynamically as URL; users are notified through email that they have work waiting at a specific URL.	PriceWaterhouseCoopers Centre, 2000

Electronic Publishing System	These systems are aimed at presenting all the information in a consistent format indipendently from the source, from the author. This is a very important issue in order to transfer information throughout the organisation. The HTML format provides good performances for what concerns the richness of the presentations and the structure of original contents, but at the same time, it allows the access through a standard Web browser. Moreover the XML (eXtended Markup Language) allows to add information concerning the structure of contents in HTML format.	Conklin, 1996, a Conklin, 1996, b Croasdell, XXX Example is MECCA III (www.amgraf.com) It is a workstation developed for the editing, pre-printing and electronic publication of information required by an organisation. It allows users to edit labels and forms and manage the security of the document. The output format supported are different: from the web to CD ROM. It includes, moreover, tools to develop manuals, brochures and pictures.
Search engines	This is a program that allows you to locate web sites via a keyword search. Think of it as the yellow pages.	www.doi.gov
Web browser	Application software that creates an interactive graphical interface for searching, finding, viewing and managing information over the internet	www.doi.gov
Knowledge charts	Collection of documents representing the organisations knowledge and information, hierarchically organised	Ruggles, 2000
Users profiles	They are the user's information needs classified in routine, significant, action and critical by a gatekeeper	Ruggles, 2000

Knowledge maps	Knowledge Map is an active visual representation of a business. It's *active*: by joining together processes and resources - knowledge, guidance, tips, checklists, forms, documents, presentations, papers, procedures, web services, training, applications, legacy systems, ... - people have the knowledge they need to see how the job is done, and to collaborate to improve. It's *visual*: It enables an intuitive method of working - people are presented with clear and compelling views of processes and resources. It is a natural way of shaping, communicating and running a business, and can be applied to a complete enterprise, or to its smallest part. The style and visualisation is flexible - use defaults, integrate with organizational standards, or break new ground. It *represents a business*: a knowledge map provides a business face for operations. Tasks are performed in the context of why they are important, and necessary resources are provided when they are needed, at a click. The *technology* for creating a knowledge map comprises an award-winning set of tools. These tools integrate with business infrastructure to make knowledge maps a natural part of the way people work.	www.knowledgemap.co.uk Example www.tsorg.com
Thesaurus	Application software providing synonyms in an easy-to-use format, succinct word definitions and an innovative hyper linked category index	www.bartleby.com
Lessons learned	A Lesson Learned is knowledge or understanding gained by experience that has a significant impact for an organisation. The experience may be either positive or negative. Successes are also sources of Lessons Learned	www.estec.esa.nl Examples are Alert An Alert is a report, originating from a user or manufacturer of a specified item, on failures or problems experienced with that item, to other organisations which may use that item, and might therefore experience similar problems. The failure/problem has to be of relevance to the community being the recipient of the information

Groupware	Groupware is an umbrella term describing the electronic technologies that support person-to-person collaboration. An organisation implements groupware systems in order to connect users who are located in geographically separated units or deparments and have to communicate each other. Groupware systems allow asynchronous communications if users can't communicate in real time. So, the main characteristic of groupware system is that they support the effort of a team to work together, especially when such people are not located in the same place or could not work at the same time. They maximise the human interaction, mininising the role of technology. Within the definition of groupware, twelve typologies of tools are included, which form a logical taxonomy: e-mail and messages (Lotus, Microsoft) group calendaring e scheduling – used to coordinate meetings, resources and dates – (Lotus, Microsoft Schedule…) electronic meeting systems desktop video and real-time conferencing (synchronous) (Group System – Ventana Meeting) Non-real-time-conferencing (asynchronous) Management of Group documents Workflow Workflow utilities and development tools Groupware services Groupware and KM frameworks Groupware applications Collaborative Internet based applications and products.	Conklin, 1996, b Orlikowski and Hofman, 1997 www.collaborate.com/publications/chapt_toc.html Liebowitz, 1999

Push technologies and mobile agents	With "push technologies" we refer to those technologies which can transfer information to final users, pushing to the users applications and contents according to the interest profiles provided. Though a push technology information are constantly "pushed" from the source to destimation. Information constantly flows to destination without any requirement from destination istelf (in pull technologies, contrarly, information flows to destination, when the requiring user makes a query). Mobile agents are a specialised typology of push technology. Such agents are controlled by the final user, who can specify which knowledge/information he wants to receive. The searching capacity of each agent vary from one to the other and provide a valid support to those who don't have time or possibility to continuously monitor the sources of information. Some characteristics of intelligent agents can be summarised as follows: *reactivity*: they perceive their environment and respond in a timely fashion to changes that occur in it *autonomy*: they perform their task without the direct human intervention, and they have control over their own actions and their internal state *adaptivity*: they automatically customise themselves to the preferences of the users on the basis of previous experience and adapt to changes in their environments *goal orientation/reasoning*: they exhibit opportunistic, goal directed behaviour and take initiative where approprite *cooperativity/sociality*: they interact with other agents or humans in order to complete their problem solving and help others with their activities *flexibility*: actions are not scripted, they can dinmically choose their actions based on their perception of the environment *self-starting mobility*: they can transport themselves from one machine to the other across different system architectures and platforms *temporal continuity*: they are continuously running to monitor environmental changes *personality*: they have well defined, believable personality that facilitates interaction with human users. To main typologies of intelligent agents can be identified: *personal assistants:* they are focused on the interaction between a user and the computer. They are computer programs that perform repetitive, burdensome tasks on behalf of their human users (for example disk back up, information filtering, information retrieval, mail management and meeting scheduling). They differentiate from regular software as their use of learning techniques to adapt to user habits, their automated reasoning to decide when to help the user. *Communicating/Collaborative agents:* such agents focus more on the interaction among computing agents. The basic issues addressed are those concerned with interactions among geographically distributed agents executing on heterogeneous hardware platforms.	Liebowitz, 1999 Maes, 1994

Data warehousing and data mining	They allow to optimise the relationships existing between the customers or suppliers and internal processes of the organisation, or developing new relationships. They allow to harmonise different views of the same data and develop a consolidated description of the data of a company.	www.datawarehouse.com
Portals	They are software tools which allow the aceess to the infrastructures of the desktop. They allow not only the link with every tool used by the user, but also with every necessary person. They usually integrate tools as groupware, e-mail, workflow, desktop applications, intranet connection, telephone, fax and video, making them accessible simply though the use of the portal. Four typologies of portals can be defined according to the services offered: *Information portals* *Collaborative portals* *Expertise portals* *Knowledge portals*	Berini, 2000
information portals	They organise sets of information according on the subjects and contents included. They provide search engines which allow, for instance, to classify included information and delivery them to whom will be interested in without any query. For example, if a user is writing a paper about a specific topic, the engine will automatically provide a list of pepers already written on the same topic.	Examples of information portals: Corporate Portal Server by Plumtree www.plumtreee.com Illuminar by Verano www.verano.com
collaborative portals	They allow a team to build up their project area. Within that area some tools are provided: conferencing system, calendar, chat, workflow, document management and security. It is possible to define a recognition or access password to reserved areas of the project or to critical applications (i.e. ERP, MRP)	Examples of collaborative portals: Knowledge Server by Intraspect www.intraspect.com Domino by Lotus www.lotus.com LiveLink by Open Text www.opentext.com

Expertise portals	They facilitate the communication person-to-person, according to people' experiences and capacities. So they foster distance learning and the exchange of messages in real time. The number of portals evolving in this direction is not huge.	Examples of expertise portals: Beehive Server by Abuzz www.abuzz.com Organic and Persona Server by Orbital Software www.orbitalsw.com
knowledge portals	The previous three categories converge in the knowledge portals. They do whatever each typology of portal can do,but in only one product. Knowledge portals should incorporate the following capabilities: Text search and retrieval. Serch engines can use one or combinations of boolean searches, baynesian searches, fuzzy logic systems and natural language processing. Personalisation and collaborative filtering. This functionality allows the individuals to create personal pages that provide links to the information and applications they are mostly interested in. Personalisation can be realised through SW agents. By providing the ability to personalise the portal, companies can ensure that knowledge workers have to deal with only the information that is directly related to their activities. Knolwedge mapping using taxonomies and linguistic analysis. Sometimes knowledge workers need to select knowledge from pre-existing categories and sometimes taxonomy makes it easier to locate the relevant documents than a full text searching would. Taxonomies are the structures by which users can navigate knowledge repositories and classification systems. They are usually hierarchical and complementary to full text searching. Devising a classification system is the first step in building a taxonomy. This ystem groups similar documents and fits them in topical categories. The categories can be defined a priori or could be self defining. Native document management capabilities or links to document management systems Workflow	Price Waterhouse Coopers technology forecast, 2000.

APPENDIX II: CONSULTANCY COMPANIES CASE STUDIES

In the appendix a brief description of the consultancy companies cases is provided. This information is useful to complete the overall description provided in Chapter 5.

COMPANY A

The company and its strategy

Company A is a global consulting company with headquarters in the US. It employs more than 4000 consultants all over the world in 69 locations. The company operates in several centres of competence (i.e. building institutional skills, business management unit, change management, corporate finance….) and in several customer industries (i.e. automotive, banking, chemicals, electronics, industrial goods…).

The mission of the company has been pointed out "To help clients to make positive, lasting and substantial improvements in their performance and to build a great firm that is able to attract, develop, excite and retain exceptional people".

The critical success factors highlighted by company A are:

-Customisation and innovativeness of the solution developed through assisting the customer in implementation and capability building.

-Strive continuously for quality: the solution developed should be extremely innovative and should be recognised on the market for its quality.

-Develop the team within the company: managers of company A pointed out the importance of people in order to reach corporate goals. The company maintains a meritocracy, fosters a non-hierarchical working atmosphere, show concern for people and stress the importance of teamwork and collaboration.

Knowledge processes

Since its origin, company A has been widely recognised for its attention to knowledge and learning. The company is organised in 15 centres of competence, which are virtual centres and not physical location, and are built around management areas of expertise already existing in the company. The role of the centres is twofold: firstly, to help to develop consultants and ensure the continuous renewal of the firm's intellectual resources. Secondly, each centre is managed by one or more experts (practice leaders), who are recognised for their expertise in the particular field. All people recruited in the company have a very high level of education (degree with maximum graduation, MBA) and the company sponsors the participation of employees in MBA programs in top business schools all over the world. Three goals are pursued with this initiative: to improve the commitment of employees towards the company, to improve their analytical and logical skills towards complex problems and to acquire knowledge from external sources. The career paths of employees within the company are in two directions. The first is the "practice-dedicated specialists" for employees who built credibility with clients through their specialised knowledge and expert application. The second option is the "practice management track" designed to provide a career progression for practice coordinators, who had a key role in transferring knowledge and in helping practice leaders manage complex networks.

Moreover, the centres of competencies are connected through an Intranet: yellow pages and expert lists are available on line and everyone within the organisation can contact an expert in a specific field. On the Intranet channels and forums are also available for online communication.

In order to facilitate knowledge generation, two main initiatives have started since 1994: first of all the Practice Olympics. Two to six teams from offices around the world are encouraged to develop ideas that grew out of recent client engagements and formalise them for a presentation at a regional competition with senior partners and clients as judges. Then, a strong investment in a global research centre has been carried out: it was established for study implications of changes in the global economy on business. This research centre is strongly related to academia.

Levers of knowledge management

	ICT	**MANAGERIAL SYSTEMS**	**ORGANISATIONAL MECHANISMS**
ACQUISITION		Research centre Recruitment MBA programs Practice Olympics	Research centre Experts
CAPITALISATION AND REUSE	Intranet	Expert List, Yellow Pages, Case Based Reasoning, Best Practices, Lesson Learned, Learning History	Expert connection Centres of competencies
TRANSFER AND SHARING	Intranet, groupware	Training Courses, Case Based Reasoning, Career paths	Centres of competencies

COMPANY B

The company and its strategy

Company B is a global consulting company with headquarters in the U.S. It employs more than 65000 consultants all over the world. It is clearly a global company in terms of customers and locations, but all the R&D activities are concentrated in the headquarters. In Italy the company employees more than 3000 consultants in three sites: Milan, Rome and Turin. The organisation of Company B is based on a matrix where people are classified according to their specialist competence and industry where they usually operate. When new employees are recruited, they start a training path to develop a specialist competence and then, according to the practice they develop, they are addressed to specific "industry areas". The specialist competences are classified into four groups: strategy, change, technology and process. Employees are all graduated (50% with a technical degree and 50% with an economic –managerial one) and only 20% has an MBA (all recruited recently).

For what concerns strategy pursued by company B, key performances outlined are: time to market and efficiency in carrying out projects especially due to the strong pressure of competitors. Therefore they pointed out as critical success factors the ability of reusing past solutions in present projects and the focus on teamwork, which is a prerequisite to carry out their projects.

Knowledge processes

The knowledge management process is based on an ICT tool ("Knowledge Xchange"). It is a system based on Lotus Notes with the creation of non-relational databases. This system was developed in 1994. In order to manage knowledge, dedicated staffs are appointed at the headquarters and specific references are located at every site. Through this system, all the phases of knowledge processes are managed: acquisition, capitalisation and reuse, transfer and sharing. The basic idea of the company is that through this system knowledge coming from every project can be acquired, codified in documents and stored.

Each project starts after an offer phase: a partner of the company is in charge of this phase. They check data concerning the customer and start an analysis. Then the partners create the "project team" and the scheduling of the activities. For the definition of costs, the partners use a "pricing model" standardised for the overall company. The offer is submitted to a European committee, and, if approved, it is delivered to the customer.

When a project starts, a new DB is created: it includes all the documents relative to the project and keeps the history of all the meetings, of the "learning history", and of all the considerations that the project manager wants to archive. Not all the documents of a project are transferred to global DB: the local responsible of Knowledge management is in charge of transferring to the headquarters only the innovative and relevant issues. Only this knowledge is transferred globally while all other documents are stored locally.

For what concerns the *assimilation* of knowledge from external sources, a Knowledge Center is in charge of this activity, globally and locally. In particular the Knowledge Centre located at the headquarters transfers relevant knowledge to all the offices with push methodologies. The *generation* of knowledge is delegated to Knowledge managers, who are in charge of abstracting "meta-knowledge" from each project according to knowledge transferred by consultants. Also the *capitalisation* of knowledge is carried out by the KM office: they use the ICT tool to store knowledge in a specific DB. All the DBs, although different in structure according to the content, have standard format and common Lotus Notes functionalities. The documents to be published in Knowledge Xchange are selected by the Knowledge Centre. Some criteria followed are related to uniqueness of the document, type of customer (new, large…) and reusability of the document. The categorisation in the system is made according to three dimensions: competence (change, technology, strategy, process), industry, and market unit. For what concerns the management tools for capitalisation of knowledge, the most common one is "Case Based reasoning" with the definition of "Expert Lists".

Finally *knowledge transfer* is mainly based on KX. It is possible to transfer knowledge directly to consultants using also push technologies. Through these technologies the consultant has not to monitor the contents of KX continuously. The navigation can be concentrated either in only one DB or in multiple DBs. Moreover each document is characterised by a "Policy document" where it is possible to find the goals, the main content and the reference persons in the DB. Finally the KX is considered as a valid tool for training as according to its contents the topics of training courses are designed.

Levers of knowledge management

	ICT	**MANAGERIAL SYSTEMS**	**ORGANISATIONAL MECHANISMS**
ACQUISITION	Knowledge Xchange	After Action Review Brainstorming meetings (videoconferencing and not), Peer Assist	Responsible of Knowledge Management, Replication of KM roles in local offices
CAPITALISATION AND REUSE	Knowledge Xchange	Expert List, Yellow Pages, Case Based Reasoning, Best Practices, Lesson Learned, Learning History	The PM analysed the documentation of the project. The local KM reviews this documentation and tranfers the relevant documents to Chicago
TRANSFER AND SHARING	Knowledge Xchange	Training Courses, Case Based Reasoning	The centre in Chicago defines methodologies to trasfer knowledge. The system, though definition of profiles, pushes knowledge to consultants.

COMPANY C

The company and its strategy

Company C is the consulting unit of a huge multinational company operating in the ICT industry. It operates in the management consulting with an approach referred as Enterprise Modelling. Company C carries out consulting activities in the banking, assurance, public administration and distribution industries. It employs 60 consultants in Rome and Milan: Milan is also the administrative headquarters in Italy. Not all people are formal employees: some of them have external collaboration contracts. The consultants are on average 33/35 years old, and are categorised as: junior, who do not have specialist competencies and do not manage the customer, middle management, who have very good relational capabilities and are the project managers, senior managers, who are over 40s and have developed strong specialist competencies. They are the majority of the company. From the organisational point of view, a brief scheme (provided by managers) is reported in figure II.1.

Company C provides its customers complete consulting service, from the strategic analysis to the implementation of the solution, especially due to the reference of the large group it belongs. In terms of strategic priorities, they are principally the time to market and efficiency, especially for the pressure of competitors. Therefore, managers of company C identified as critical success factors: the development of a methodology common to all the consultants operating in the company, the ability of developing solutions for new customer requirements (i.e. ebusiness, €) and price competition.

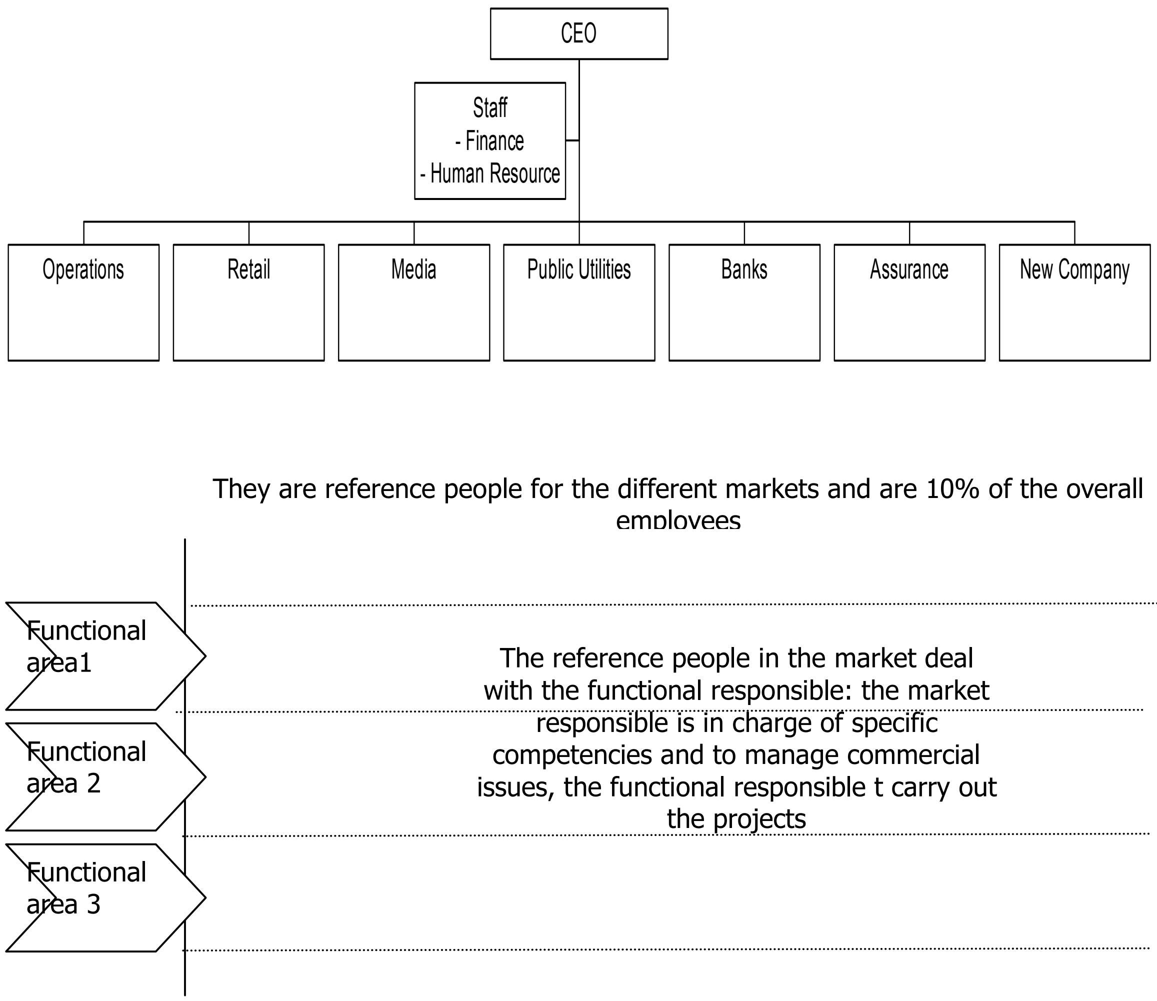


Figure II.1: The organisation of company C

Knowledge processes

The role played by consultants in knowledge processes is extremely important for the company. Company C stresses the importance of sharing learned experiences and transferring them in the knowledge base. The approach to KM is based on the use of proprietary technology: a DB with libraries and an environment with visual basic for the access. This tool is available to all the members of the organisation, collaborators included. All employees share their experiences with the others. The update of contents is delegated to expert "modelisators", who carry out also the classification, and capitalisation of knowledge. Due to the size of the company, most managerial and organisational solutions for knowledge management are informal, based on exchange of ideas and experiences in "meeting spaces". Now the company is growing and the managers are trying to formalise meetings and appointments to share experiences also outside the management of the projects.

In more detail, the *acquisition* of knowledge is based on two mechanisms: recruitment of new employees and initiatives of consultants. Consultants provide synoptic descriptions of the projects, capturing their experience and transferring it to modelisators who have to integrate it into the knowledge base. At the same time the modelisators use to participate in seminars, external meetings and publications in order to increase their competence. In order to foster consultants in acquiring knowledge, "After Action Reviews" are adopted. Nevertheless, although the synoptic descriptions of the projects are stored, most knowledge remains tacit and is owned by consultants. The *capitalisation* of knowledge is so managed at two levels: the modelisators integrate knowledge provided by the consultants into the knowledge base, but at the same time most knowledge is stored tacitly by consultants; modelisators update the "Yellow Pages" and "Expert lists" to access this knowledge.

For what concerns the *transfer and sharing* of knowledge, people usually transfers codified knowledge through documentation to be stored in the DBs. At the same time, most important knowledge is usually transferred informally through discussions in "meetings spaces".

Levers of knowledge management

	ICT	**MANAGERIAL SYSTEMS**	**ORGANISATIONAL MECHANISMS**
ACQUISITION		After Action Review, Recruitment, Contacts with universities, seminars	Modelisators in charge of monitoring external events
CAPITALISATION AND REUSE	DB with libraries, Visual Basic environment	Expert List, Yellow Pages, Case Based Reasoning	Process responsibles, modelisators involved in the phase
TRANSFER AND SHARING	DB with libraries, Visual Basic environment	Meeting Space, Informal mechanisms	The responsibility is delegated to everyone. The managers are in charge of creating an organisational climate for knowledge transfer

COMPANY D

The company and its strategy

Company D is the Italian subsidiary of a multinational and global consulting company. Consultants carry out strategic management consulting in the IT area, relying on a success methodology developed in the U.S. by the founder of the company. Company D employees in Italy about 25 consultants and collaborates with a large number of other consultants with different contracts. The employees are very experienced and their average age is rather high. Differently consultants collaborating with company D are usually rather young and not really specialised.

The consultation carried out by company D starts with an assessment of the customer exploiting the proprietary methodology. The output of this phase is usually a "development plan" and an analysis of the effects of new IT system on the organisation. Since the foundation, Company D has not been engaged in implementing the solutions, as their activities have been dedicated to strategic consulting. Recently the company is considering the possibility to integrate the activities with another company of the group, which carries out the implementation of IT systems. This could allow company D to approach the customer with the possibility of delivering a complete service. Managers of company D have indicated, as key priority, efficiency in carrying out their consultations, which is facilitated by the use of the proprietary methodology. Moreover, they have indicated that know how of consultants in IT is extremely important for the quality of the consultation. However, it is very difficult to reach due to the high level of turnover.

Knowledge processes

For what concerns the knowledge processes, the *assimilation* of knowledge from external sources is primarily carried out through the involvement of external consultants collaborating with partners in the development of a new offer. They are usually involved in this phase due to their specific competence in terms of industry or topic of the consultation. Moreover, all the partners have to practice the "knowledge job rotation": every year the responsible of a specific area is changed. The partner in charge of a certain area, for one year is responsible of acquiring knowledge from external sources. *Generation* of knowledge is usually carried out by partners, who abstract and generalise knowledge coming from consultants and collaborators operating on a specific project. Partners require consultants to provide a "knowledge elicitation interview", which is an interview carried out by partners asking consultants specific issues concerning the project in a sort of "retrospect", in order to find possible areas of improvement and possible solutions. Partners are the only ones able to generate improvements, as they own the overall knowledge about the project.

Then, all the partners meet (every last Friday in a month) in a sort of "brainstorming meeting" where knowledge acquired by the consultants in the projects is shared. The minutes of these meetings are recorded on CD-ROMs.

The *capitalisation* of knowledge is usually managed by partners who are in charge of storing tacitly and codify knowledge on the CD ROM. Partners decide which knowledge is important to codify and include in the CD ROM. They own the responsibility on the use of the CD ROM itself and they decide if and when they can allow the use of it by consultants. In order to classify knowledge about the cases, partners rely on "case based reasoning methodologies" and "expert lists".

Transfer of knowledge is usually supported by the CD ROM and meetings among partners, who are usually involved in the discussion of cases in terms of contents, similarities of cases, and relevance for development of future practices. In order to stimulate the transfer of knowledge from partners to consultants, usually mentoring practices are adopted.

From this description it emerges the peculiarity of the role of partners within knowledge processes: they are in charge of acquisition, capitalisation of knowledge and they are the responsible of the process itself.

Levers of knowledge management

	ICT	MANAGERIAL SYSTEMS	ORGANISATIONAL MECHANISMS
acquisition		Knowledge JOB Rotation among partners Knowledge elicitation interview Contacts with universities, seminars	Partners collaborating with external consultants
capitalisation and reuse	CD ROM	Expert List, Case Based Reasoning	Partners are responsible of business and knowledge activities
transfer and sharing	CD ROM	Mentoring Brainstorming meetings among partners	The responsibility is owned by partners

COMPANY E

The company and its strategy

Company E is part of a global consulting group with headquarters in the U.S. and offices all over the world. The main activities of company E concern the strategic consulting and they are widely recognised for their ability to deal with new problems and suggest solutions with a short time to market. Company E employs about 250 consultants and the employment of new consultants is very slow and controlled. Turnover, on the other hand, is about 75 million € and is continuously growing. They use to provide consultations about methodologies and frequently also analysis of possibilities.

The hierarchy of employees is represented in terms of partners, managers, seniors, juniors and associate consultants. Usually company E employees people who are at least 28 years old and with a post graduate Master. The recruitment of new consultants reflects very strict criteria, especially related with strong competences in consulting (especially related to specific industries).

Managers indicated how to reach good performances; consultants of company E have to improve their ability to generate knowledge from experiences and to provide always-new solutions and methodologies to the customers. In fact, key priorities of company E have been indicated as customisation of the solution and innovativeness, which are becoming extremely complex, due to the increasing number of customers and markets. One particular critical process, where knowledge processes are extremely important, is the offer management. This process starts with the analysis of characteristics of the customer in terms of size and type of problem (which should match the competencies of the group). A partner and a manager carry out this activity. The partner, in particular, according to the characteristics of the new case, looks for similar cases carried out by company E in the past through accessing a library of cases and contacting the partner who managed that project. The offer is developed starting from available knowledge about past projects. After the approval of the offer, the project team is defined and periodically reflections about the case are carried out and formalised in reports. At the end of the project the "Case Summaries" are developed and they are available for partners only.

Knowledge processes

The knowledge management process presents two main characteristics: first of all knowledge is a management task, as partners are in charge of acquisition, capitalisation and codification of knowledge. On the other hand, a "knowledge management team" located in the U.S. is in charge of maintaining the Intranet where codified knowledge is published. There are therefore two levels of knowledge managed in company E: tacit knowledge stored by partners and explicit and public knowledge available through the Intranet. In any case, it is very important to note that the partner can keep the documents of the customer for 5 years, and then they destroy them. The consultants, on the other hand, can keep the "working documents" for 12 months.

In more detail, the *acquisition* of knowledge is principally carried out by partners: they are in charge of a specific area of content (i.e. ebusiness) and they have to scan and acquire knowledge about this area also from external sources. All the partners operating in the same area all over the world meet every week in the "Call Conferences" or "Practice meetings" where they discuss about problems and issues emerging in the area. Moreover, methodologies such as "Lessons Learned" and "After Action Reviews" are implemented to capture knowledge from experience.

The *capitalisation* of knowledge is organised into two phases: the first one is owned by the partner responsible for the project, who checks and validates all the documents prepared by the manager ("historian") operating in the project on the base of the experience of consultants. Then, the "knowledge management team" operating in U.S., integrates this knowledge into the knowledge base and publish it on the Intranet. In the knowledge centre, a "Chief knowledge officer" has been appointed. He is in charge of defining and improving all the mechanisms to manage knowledge within the organisation. Moreover the capitalisation of knowledge relies on methods as Expert Lists, Yellow pages, learning histories and lessons learned.

Finally, *transfer and sharing* of knowledge is mainly based on the identification of the expert on a specific topic. The contact can be made through video conferencing facilities or telephone, always supported by the exchange of relevant documentation. Moreover, two virtual centres have been developed in order to transfer explicit knowledge. The first one is "company E virtual university" which aims at training people on specific topics and methodologies, relying on consolidated training models. In this virtual centre charts, wizards for training and knowledge transfer are presented. The second one is "global eXchange centre" (GXC) which is articulated in different access levels and it is principally targeted to partners. It stores knowledge about customers, projects, competencies, profiles and it is principally used in the offer phase.

Finally company E has formalised several training courses to support people in carrying out knowledge processes ("associate consulting training", "consultant training", "new partner training" "success cases").

Levers of knowledge management

	ICT	MANAGERIAL SYSTEMS	ORGANISATIONAL MECHANISMS
acquisition	WWW, forum on line	After action reviews, brainstorming meetings, peer assist	Partners manage the acquisition of knowledge. They create a strategic community
capitalisation and reuse	Intranet, case based reasoning	Expert List, Case Based Reasoning, best practices, lessons learned, learning histories	1 first check and validation by partners 2. chief knowledge officer and centralised team for publication
transfer and sharing	Intranet (company E corporate university, GXC), groupware, archives, expert lists, videoconferences	Expert lists, yellow pages, training need analysis, practice meeting, workshop, forum, mentoring, training courses.	Facilitated by the centralised team in the U.S. and then validated by partners at the office level.

COMPANY F

The company and its strategy

Company F operates at a global level with offices worldwide and more than 1000 consultants in Italy. The main service provided by company F is consulting about ERP systems for big companies (in terms of turnover) and especially multinational companies. The consultants are mainly employees and only sometimes, according to the requirement of specific competences the company involves in the project external collaborators. Employees are on average very young and recently their number has increased a lot.

In terms of strategy pursued by company F, key performances outlined are: time to market and efficiency in carrying out projects especially due to the strong pressure of competitors. Therefore, they pointed out as critical success factors the ability of reusing past solutions in present projects and the focus on teamwork which is a prerequisite to carry out their projects.

Knowledge processes

The knowledge management system developed by company F is considered to be "pioneering" amongst its competitors. It is principally based on a knowledge web (which is a recollection of content and associated infrastructure) which is complemented by three internal knowledge-oriented "centres" which are responsible for managing the acquisition, capitalisation, transfer and sharing of knowledge throughout the overall global organisation.

In more detail, the knowledge web is a network integrating hundreds of knowledge bases and other resources accessible via unique interface. The main users within the company are the field consultants.

The centres are:

-Centre for Business Knowledge (CBK). This centre is based in the U.S. and it is responsible for gathering and filtering the firm's knowledge offering several services: call centre (to assist consultants in quick and simple requests, and without any billing system. IT is accessible through call, email and fax), business research (which handles any question from consultants requiring more than 30 minutes to be answered. Time is billed to the project), business analysis (in charge of providing reports for specific industries and clients including executive summaries, competitive analysis, strategic financial analysis), knowledge base administration (in charge of maintaining the classification structure of the knowledge web), coordination of knowledge networks (in charge of supporting the matter experts in the firm to collect, filter, package and deploy knowledge in their area of expertise), management of relationship with external information vendors (in charge of integrating of information coming from external vendors)

-Centre for Business Transformation (CBT). This centre is in charge of developing the technology enabling and tools to support company F consulting and service delivery efforts.

-Centre for Business Innovation (CBI). This centre is responsible for generation of knowledge, through bridging the gap between academic leading edge thinking and more practical application to company F customers. People operating in this centre usually hold roundtables in order to research new business concepts and examine how these concepts can be applied to customers.

The knowledge web, finally, is the basic interface between the knowledge base and consultants. It is based on Lotus Notes and Internet web technology. It includes link to external information, discussion databases, practice area database and internally created knowledge bases about global leading practices, competitive intelligence, and firm-wide administration.

From the organisational point of view, it is important to highlight that company F encourages consultants in specialisation on a specific industry (i.e. aerospace industry) on business process area (i.e. supply chain management) and on core service (i.e. business transformation or system development). Individuals with specialty in an area are a "knowledge network". The networks are coordinated by CBK and are in charge of identifying new topics in the area of expertise.

According to those levers, CBI and CBK principally carry out *generation* of knowledge, scanning of knowledge from external sources, and capturing knowledge coming from knowledge networks, especially through methodologies as after action reviews and knowledge elicitation interviews. *Capitalisation* of knowledge is always carried out by those centres and it relies on the use of the formalised knowledge bases, which store explicit and generalised knowledge. Knowledge capitalisation relies also on Case based reasoning and expert lists. Finally, knowledge *transfer and sharing* is fostered by the use of virtual communication means (videoconferencing and meeting space).

Levers of knowledge management

	ICT	**MANAGERIAL SYSTEMS**	**ORGANISATIONAL MECHANISMS**
acquisition	Knowledge web	After action reviews,	Knowledge networks, CBI, CBT
capitalisation and reuse	Knowledge web, databases and knowledge bases	Expert List, Case Based Reasoning, best practices, lessons learned, learning histories	CBT and CBK
transfer and sharing	groupware, expert lists, videoconferences	Expert lists, workshop, forum, meeting space	Knowledge networks, CBI, CBT

COMPANY G

The company and its strategy

Company G is a consulting company primarily supporting companies in their business process reengineering. It operates in the area of organisational and people development in the case of organisational change. Company G integrates also activities of consulting, applied research and training. It employees about 100 people in two locations: Milan and Rome. The partners of the company are 14. Most of people are employees with an average age of 40 years.

The main areas of business are: human resource management, training, organisation (structure, processes efficiency, project management) and marketing and sales. 30% of the turnover comes from training area. Partners are operating as experts in the areas of business but especially as client leader.

Managers of company G have pointed out that their area of improvement is internationalisation: they have difficulties in dealing with multinational companies.

In terms of innovation strategy of company G, managers define themselves as "craftsmen" as they use to develop highly customised and innovative solutions and methodologies for their customers. This usually requires too long time to market, especially in cases of strong competition.

Knowledge processes

Company G underlines the role of knowledge management and its effects on knowledge and business processes. The knowledge management system is based on a proprietary ICT tool with libraries and a visual basic environment to support access. This tool is available for all members in the organisation, including external collaborators. The company emphasises the importance of sharing experiences.

Due to the relatively small dimensions of the company, no organisational and managerial mechanism has been adopted so far to support knowledge processes. Most mechanisms are informal and facilitate the exchange of experiences through periodical meetings.

In more detail, the *acquisition* phase is fostered through recruitment of new consultants and through interaction with the customer. During each project consultants have to fill in some forms about the characteristics of the customer and the project. They will be included in the Intranet.

There is a small team of "modelisators" who are in charge of the analysis of the documents and publication of the intranet. They do not have a formal role within the process, and mainly support the publication of documents. Similarly, the *capitalisation* phase is carried out in two ways: first of all through indicating people who carried out projects. They store tacit knowledge about the project and can be contacted in order to retrieve knowledge. Moreover, the documents filled in are available on the Intranet. They do not provide detailed knowledge about the project, but they are useful to identify the consultants who carried out the most similar project in the past. Capitalisation therefore relies on methodologies as "yellow pages", "expert lists" and "case based reasoning". Finally, for what concerns *transfer and sharing*, all consultants are encouraged to access knowledge available. Other frequently used mechanisms are meetings, due to the relatively small size of the company.

Levers of knowledge management

	ICT	MANAGERIAL SYSTEMS	ORGANISATIONAL MECHANISMS
acquisition		After action reviews, recruitment, university, seminars	Consultants acting with customers
capitalisation and reuse	Databases and libraries, visual basic environment	Expert List, Case Based Reasoning, yellow pages	Experts and documentation available on ICT
transfer and sharing	Databases and libraries, visual basic environment	Meeting space, informal mechanisms	Diffused responsibility: everyone has to share knowledge

COMPANY H

The company and its strategy

The company is part of a group, mainly operating in Europe. It employs about 700 people. The average age of employees is 30 years and the labour turnover is about 40 % every two years. The consulting service offered is related to ICT development, implementation and support: information systems, design of local area networks, ebusiness solutions, organisation design and change management.

The consultants operate in different areas of expertise within the company: organisation, hardware, software and technologies. In order to exploit synergies between the areas, company H indicated knowledge management activities as strategic for the success of consulting projects.

Company H indicated its critical success factors:

-Strong orientation towards SMEs: the company has developed a methodology for the analysis of the problem, which is extremely formalised and cheap. Usually the analysis phase has an effect of less than the 5% on the total consultancy cost. This allows the company to keep a low price, which is affordable also for SMEs.

-Good prices: a consequence of the previous characteristic is the ability to keep a competitive price. This is due to standardisation of some phases of the consultancy project.

-Good ICT culture: which reflects both internally, in management of internal activities, and in the projects of the customer.

-Customisation and innovativeness of solution.

The consulting service, which is based on the development and implementation of an ICT solution, can be referred to as "complete" service: from the analysis, design, implementation, change management and support.

Knowledge processes

The internal ICT structure is based on an Intranet and every employee can access it remotely. The Internet access, on the other hand, is used to assimilate knowledge from external sources, in particular web sites. Every worker uses the Internet and Intranet and they are encouraged by the organisation to increase their competencies using them. *Assimilation* of external knowledge is also supported by participation to meetings and conferences.

The *generation* of knowledge is stimulated by the organisation through after action reviews: consultants comment the history of each project and then store it in archives on the server. Moreover, brainstorming meetings are also arranged: every month a group of consultants analyses the activities carried out in order to discuss critical issues and to find opportunities for improvement of the current consultancy methodologies. In these meetings the role of the CEO is extremely strong. CEO manages also the *capitalisation* phase: he is in charge of integrating knowledge emerging from consultants to the previous body of knowledge and to external experts. Moreover he owns also the list of experts within the organisation: yellow pages and expert lists are developed and mainly managed by the CEO. These experts, who are the responsible of the business units within the company (organisation, hardware, software and technology) are in charge also of managing knowledge within their business unit and directly report to the CEO.

The knowledge *transfer* principally relies on groupware supporting person-to-person relationships.

Levers of knowledge management

	ICT	MANAGERIAL SYSTEMS	ORGANISATIONAL MECHANISMS
acquisition	Internet access	After action reviews, seminars and meetings	CEO contacts
capitalisation and reuse	Archives on the server unit, Intranet	Expert List, Yellow pages	Responsibility of CEO and experts.
transfer and sharing	Groupware facilities, INtranet	Brainstorming meetings, after action reviews, informal mechanisms	Responsibility of CEO and experts.

APPENDIX III: INVESTIGATION QUESTIONNAIRE

SECTION 1: General information about companies

In the following section, the questions concern the main characteristics of the company. Please answer them, indicating which you think are the more critical ones in terms of impact on the knowledge management process

1.1 The company

- Which is the company size?

Prompt:

Ownership, number of employees, turnover, export percentage.

- Which are the main activities of the company and which is the most representative product/service?

Prompt:

Turnover of the most representative product, and position in the supply chain

1.2 Where are the activities of the company located?

- **Which is the reference market?**
- **Where are the main activities carried out??**

Prompt:

Operations, R&S, Logistics, Purchasing

1.3 Competitors

- **What are the key performance? How are you positioned comparing with the average in the industry and with the most important competitor? Which was your position three years ago?**

Prompt:

Key performances: innovativeness, time to prepare the offer, time to develop the service, quality and reliability, costs, integration of the service, customisation, efficiency.

- Which are the main characteristics of the industry in terms of concentration and growth?

Prompt:

Concentration and growth

-How many competitors do you have?

Prompt:

Number of competitors, leader or follower position, relative market share of the main product/service.

1.4 Complexity

- **Which are the main critical issues for the company in terms of impact on performances?**

Prompt:

Portfolio issues: product/service range;

Product issues (most representative product): number of components/parts/activities toi manage, relationships wih suppliers, technologies involved, competencies/skills required.

System issues: (most representative product): relationship with customers.

1.5 Personnel management

- Which are the main characteristics of employees?

Prompt:
Employees/external contract personnel, labour turnover, average age, sex.

-Which is the education level of the employees?
Prompt:

Percentage of employees with secondary school diploma, percentage of employees with degree

1.6 Key processes organisation

-Ask a copy of the organisation chart
-What are the main organisational processes? How many employees work in those processes?
Prompt
Operation processes, support processes.

-Which are the activities carried out by each organisational unit involved in the main processes?

-Which role is performed by each organisational unit in the processes?
Prompt:
Responsibility, Collaboration, Management of internal activities (there are not activities completely carried out by other organisational units)

-What are the interfunctional relationships?
Prompt:
Hierarchical,Horizontal…

REPORT

1.1 Characteristics of the company and of the industry

The information collected in section 1.1 can be organised in the following tables

Areas of activities	Main product/service	Percentage of turnover of the main product/service	Position in the supply chain for consultancy companies
			- Main contractor - Sub contractor

The information collected in **section 1.2** can be organised as follows:

	Local (one national site)	More national sites	Sites concentrated in only one geographical area	Global
Market				
Operations				
R&D				
Supply chain				

Information about section 1.3:

Key performances	Industry (indicate the level of importance)	Company[1]
Market		1 2 3 4 5
Operations		1 2 3 4 5
R&D		1 2 3 4 5
Supply chain		1 2 3 4 5

Industry		Competitors (representative project)		
Concentration	Trend	Number of competitors	Position (leader/follower)	Market share compared with main competitor

[1] For each key performance indicate in a Likert scale (1=really worse; 2=worse; 3=similar; 4=slightly better; 5=better) the position of the reference competitor (now and three years ago) and of the industry (now and three years ago) compared with the company.

1.4 Complexity

In this section information concerning section 1.4 in the questionnaire should be organised

Key performances	Factors	Level of importance	Number/not-homogeneity[2]	Variability over time	Interdependence	Overall indicator for complexity
Portfolio complexity						
Product complexity						
System complexity						

[2] Associate to each factor a level of importance according to a scale 1-3 (1=not so important; 2=important; 3=very important). In this column, as for the following ones, it should be indicated if the complexity of a factor derives from the number/not homogeneity and/or the variability over time and/or their interdependence.

1.5 HR management

Concerning section 1.5 of the questionnaire:

Employees/External contracts	Labour Turnover	Average age	Sex

For what concerns the level of qualification of personnel:

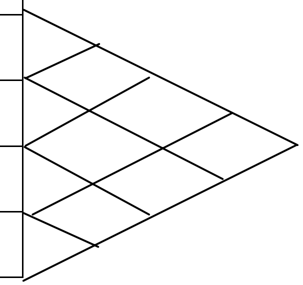
Education	%	%	Type
Diploma			Technical schools
			Liceum
			Other
		100%	
Degree			Technical-scientific degrees
			Economic degrees
			Humanistic degrees
		100%	

1.6 Key processes

Consultancy companies	
Key processes	% Work force

Consultancy companies	
Support processes	% Work force

	Key processes									
Functional units	Process 1		Process 2		Process 3		Process 4		Process 5	
	Role[3]	Main activities	Role	Main activities	Role	Main activities	Role	Main activities	Role	Main activities
Unit 1										
Unit 2										



[3] Relationship functional units/processes: indicate the existing type of relationship between the functional units and the processes, as follows:
-R=general responsibility: most of the activities are carried out within the functional unit, but other activities managed in different functional units exist.
-C=relevant involvement: some activities of the processes are carried out in the functional unit
-GI=internal management: no activity carried out in other functional units.

SECTION 2: Technological infrastructure

2.1 Hardware

- **How many PC (at least Pentium II) are there in the company (in relation with the number of employees)?**
- **Do you use multimedia tools?**

Prompt:
number of scanner, CD writer, web cam, other multimedia tools.
which type of network architecture has been developed?
Prompt:
number of users with email address, number of positions with Internet access
number of LAN servers
existence of Intranet,
link with remote locations via Modem, direct connection through dedicated line, Internet (via Web)

-How is the communication with customers managed?
type of informative flows with customers - type of integration during the offer, project and implementation phases.

2.2 Software
-Which are the main application programs used to:
-Transfer and share information within the company
Prompt:
Intranet, Web Site, Portals, Groupware, ERP,
-Store information and knowledge
Data Warehouse,EDMS, DataBase Objetct Oriented, Archivi Best Practices, Project Database…
- Communicate with external people
Intranet, Extranet, Groupware, CD-Rom, Supply Chain programs , EDI

-When has the tool been introduced (more than three years ago, since the last three years, it is in the implementation phase now) ?

- How frequently do you use them (sometimes, frequently, always)?
- How much is it diffused (only one individual, in one organisational unit, in more than one organisational unit)?

2.3 Support for the specific process
-In the process (indicate which one), what hardware and software is used?
Specify the goals each tool is used for.

2.4 Proximity between ICT unit and Top Management
- Which are the roles of the ICT responsible and of the ICT team within the organisation?

internal or external member
provides general indications about acquisitions
contributes in determining the company strategy for what concerns ICT
reports directly to CEO
manages maintenance
plans carries out training
develops applications and customisation

- Which % of turnover is invested in ICT?
if possible specify HW, SW, support and training

2.5 Personnel for ICT

- % of people working in ICT area

- training hours per year (to people working in ICT unit and not)
- is training internal or external?
- How frequently do you organise updating courses?

REPORT

2.1 Hardware and network infrastructure

Include information collected in 2.1. Describe the network

2.2 Software

Information collected in 2.2 should be organised in order to show the categories of software:

- applications for transfer and sharing of information/knowledge
- applications for storage
- applications for communication (internal and external)

Indicate also when each application software has been introduced, the level of diffusion and frequency of use.

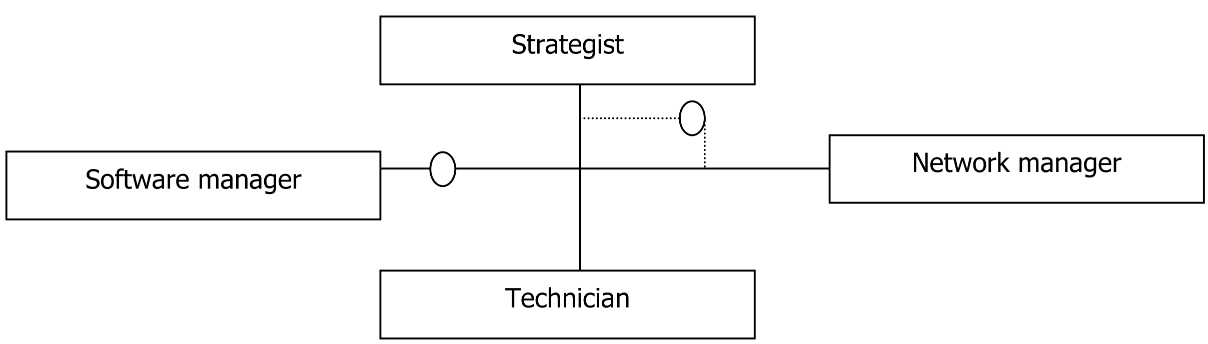
Data can be organised as follows:

Application software	Introduction	Diffusion	Frequency of use
	-more than three years ago -in the last three years -it is in the implementation phase	-only one individual -a team -organisation	-sometimes -frequently -always

Application software	Application and type	Application and type
Transfer and sharing		
Storage		
communication		

2.3 Proximity between ICT and Top Management

Briefly describe the information in 2.4 in the following scheme:



SECTION 3: Description of the operative process

3.1 Mapping of the selected process
- What are the main activities?
- Who is involved in those activities?
- What are the main physical and information flows?
- How are these flows supported or hindered?

3.2 Identification of critical knowledge
- **What knowledge and competencies are required to carry out each activity?**
Technica l, commercial
which decisions should be taken
who takes decisions
which knowledge is required to take decisions

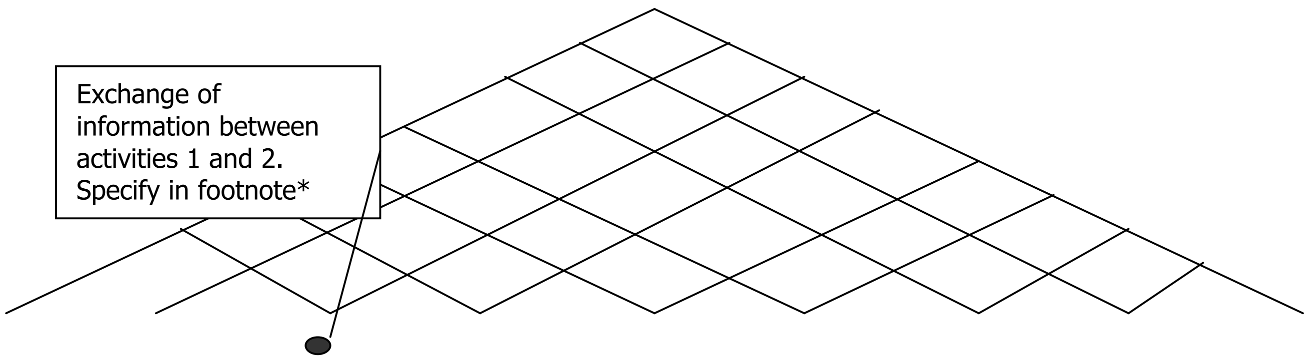
-Which mechanisms facilitate the use of this knowledge?
-Which barriers hinder the use of this knowledge?

3.3 Relevant changes
- Which relevant changes have been carried out in the process?
- For which reasons?
- With which effects?

REPORT
3.1 Mapping of a process
Selection of a process relevant from the knowledge management point of view, and mapping of phases and roles.
It is necessary to justify the choice of the process in terms of relevance for the business and importance for the management of knowledge.
Each phase should be described in terms of:
- Physical and informative input
- Main activities
- Actors (internal and external) and roles
- Types of decisions taken (i.e. investment evaluation, planning…)

3.2 Identification of critical knowledge
Identification of most important knowledge for the process in the different phases.
Identification and description of organisational mechanisms to support this knowledge
Identification and description of barriers
Summarise information in the following figure.

3.3 Relevant changes
Description of relevant changes in the different phases of the process. In particular it is important to make explicit the motivations driving these changes (technologies, resources, labour turnover…) and which improvements have been reached.



	Activity 1	Activity 2				Activity N
Informative Input						
Informative Output						
Actors**	Roles and types of decisions taken					
	Knowledge required in the activities and sources					

*Indicate the type and sequence of activities 1 and 2:

S: sequential
O: overlapping
It is then necessary to specify which are the main mechanisms of support and organisational barriers and moreover the external sources of information.

** Indicate the role of the different actors and the type of decisions to take in the different activities they are involved:

R: responsible
E: main actor carrying out the activity (execution)
C: involved

SECTION 4: knowledge management
Before starting the interview, the phases of knowledge processes have to be defined: :
The phases can be defined as follows:
1. Acquisition of knowledge (generation and assimilation from external sources);
2. Capitalisation and reuse;
3. Transfer and sharing.
The interviewer should explain the different phases.
For each phase, then, answering the following questions (the text is specified for the acquisition phase)

4.1 Challenges in each phase
-How important is the phase of Acquisition for the competition in your business?

Very important, important, not so important
Planned investments to support this phase
Barriers to acquisition of knowledge
Culture of employees
How the companies support the cultural change

4.2 Levers
-How does the organisation support the acquisition of knowledge (forms, tools and methodologies)?
-What type of knowledge is acquired?
-Who acquires knowledge in the organisation?
-Which levers foster the acquisition of knowledge?
ICT: push technologies, mobile agents, data mining, web sites, intranet, extranet, portals
Management systems: benchmarking, peer assist, new personnel
Organisational mechanisms: CKO, diffused responsibilities…For each lever implemented, discuss its functionality and its relevance within the organisation.

The following section is dedicated to the description of the benefits of knowledge management in terms of:
-effectiveness of KM;
-effects of KM on the operational process.

4.3 KM performances
-How frequently does the organisation refer to past experiences in order to design new projects?
(Always, often, sometimes, seldom, never)?

-Did you find difficulties in the use of the new ICT?
-Is it difficult to retrieve knowledge from the past?
Some difficulties can be:
- *to find and retrieve necessary knowledge*
- *to apply acquired knowledge due to different contexts*
- *to standardise knowledge*

- Is available knowledge useful?
  - knowledge is obsolete and not accurate
  - references to people are missing

-Which are the main behaviours of people and groups operating in the projects?
B1. Individuals and groups use the strategic goals and objectives of the product innovation process to focus and prioritise their improvement and learning activities

This is the combination of behaviours which results in peoples' attitudes towards selecting learning goals according to the priorities of the product innovation process. Management plays a crucial role in deploying corporate strategy and translating it into concrete improvement needs to which human resources can be committed.

B2. Individuals and groups projects as opportunities to develop knowledge

People consider experimentation and learning as a part of the objective of each product innovation project. Failures are not condemned but regarded as experiences that can provide useful knowledge for further innovation activities. In planning and managing innovation projects, management pay close attention at balancing short-term objectives with the need for developing and diffusing knowledge for the overall organisation.

B3. Individuals use part of the available time/resources to experiment with new solutions

People have spare resources, in terms of time and/or budget that can be devoted to activities that are explicitly aimed at developing knowledge or testing new solutions. Managers generally leave people a high degree of freedom in deciding how to use these spare resources to pursue innovation to which they feel personally committed.

B4. Individuals integrate knowledge among all the different phases of product innovation

People transfer and retrieve information from one phase to another of the innovation process (e.g. between design and manufacture, between service and design) perceiving all the different phases of the innovation process to be closely related to each other. Organisational, space and time barriers that can emerge in this transfer are overcome by managerial and cultural awareness of knowledge transfer and integration.

B5. Individuals transfer knowledge between different product innovation cycles.

People make explicit and communicate experience between different innovation processes and projects. They are aware of the value of sharing knowledge acquired in different PI processes / projects, and recognise the importance attached to this by the organisation. Similarly, when coping with a new problem people consciously look for previous experience that might be relevant.

B6. Individuals abstract knowledge from experience and generalise it for application on new processes/projects

People analyse their experiences to try to identify knowledge and information that are really important and may be applied in other situations.

B7. Individuals embed knowledge, making the knowledge available to others by incorporating it in vehicles such as reports, databases, product and process standards that can be more widely disseminated and retained over time

Individuals embed knowledge, making the knowledge available to others by incorporating it in vehicles such as reports, databases, product and process standards that can be more widely disseminated and retained over time

B8. People try to assimilate and use knowledge from external sources

People act on their awareness that external actors (competitors, universities, research centres…), though not directly involved in the PI process, can be valuable sources of knowledge that can be usefully combined with the internal knowledge.

-How often is/was each behaviour seen within the team operating in projects?

	The behaviour was never shown	
	The behaviour was only rarely shown	
	The behaviour was shown rather frequently	
	The behaviour was very frequently shown	
	The behaviour was always shown as a part of day by day work	

4.4 Performances of the operative process
-Which benefits can be observed in the business process due to the availability of knowledge?
-How can these benefits be measured?
-Shorter times to execute processes
-Lower costs
-Better solutions delivered
-Individuals work better in team

REPORT
4.1 The knowledge (management) process
Introduction to KM in the company. Indicate the level of awareness, systematisation of the process, the relevance of the process itself

For what concerns each phase:
4.2. For each phase
Please indicate briefly how each phase is designed, the critical issues, the relevance and how ewach phase is supported. Highlight ICT, organisational mechansims and managerial systems adopted and how it contributes to reach the goals.

4.3 Summarisng table

	ICT	**Managerial systems**	**Organisational mechanisms**
Acquisition			
Capitalisation and reuse			
Transfer and sharing			

APPENDIX IV: SURVEY IN THE ACTION RESEARCH CASE

1. Ordinate, according to the level of importance (1 is most important and 6 is least important), the type of knowledge which is more useful to a TBP in order to be successful in managing the relationship with the customer.

Example: A: 1(most important)

B: 2

C: 3

D: 4

E: 5

F: 6 (least important)

Knowledge about the company and its strategy	
Knowledge about competitors and their strategy	
Knowledge about the offer of the company	
Knowledge about the offer of competitors	
Knowledge about technologies and regulations of TLC	
Knowledge about customer needs and behaviours	

2. Ordinate as in the previous example (from 1 to 4), the characteristics of a successful TBP sales person.

Ability in communication and negotiation	
Background and professional knowledge	
Interpersonal relationships with the customer	
Better product/service provided	

3. How long have you been working for company K?

4. Select a score from 1(very much) to 5(not al all) for the following questions related to the implementation of the Knowledge Management System (KMS)

	Before the KMS	*After the KMS*
Level of perceived competencies	1 2 3 4 5	1 2 3 4 5
Collaboration with the managers of company K	1 2 3 4 5	1 2 3 4 5
Collaboration with your boss (TBP)	1 2 3 4 5	1 2 3 4 5
Updated information are easy to retrieve	1 2 3 4 5	1 2 3 4 5
Ability in management the selling activities (negotiation)	1 2 3 4 5	1 2 3 4 5
Learning (learning curve)	1 2 3 4 5	1 2 3 4 5

APPENDIX V: WEB QUESTIONNAIRE FOR SALES PEOPLE IN COMPANY I

We need your help to make the PBU Web work better for you

Sales force questionnaire

Company I has a wide and precious source of knowledge to succeed in the optical business: the WEB; its intranet is defined the "state of the art" of knowledge management systems, a milestone in managerial literature. The aim of our survey is to find web tools able to support you in your selling activity: to give you the right info in a few seconds, to enable experience sharing with other Company I accounts throughout the world in a way that best practices can emerge.

To do these things we need your help and your collaboration, in exchange we offer a real commitment in creating something new and useful for your job and most of all we'll tell you as soon as possible the results of this research, so that you'll be able to see if your needs match with the ones of your colleagues in other theatres.

The questionnaire is divided in six main sections:

It will take only few minutes of your time to fill in!
Try to answer all the questions, even though incomplete questionnaires will be valued as well.
In particular it will be very useful for us if you spend a little time filling in the free answer questions.

Thank you all !

Market segmentation

In which theatre do you work?

○ EMEA	○ Asia/Pacific	○ Japan	○ USA	○ America

Which is your target customer?

U.S.:	○ IXC	○ NSP/CLEC	○ ILEC
EMEA:	○ PTT	○ Pan European	○ Alternative Operator
Asia/Pacific; Japan; America:	○ Incumbent	○ New Players	

Which of the following categories better represents the needs that your customer wants to be satisfied by your proposal?

Functionality/Price	Complementary Services	Total solution	Other	
Describe in a few words which are the key points for your customers:				
[redacted]				

Transaction nature and description

Can you briefly describe the main phases of a typical transaction and the role you play in managing each phase?

e.g. Phase: tendering; Role: coordinator; Relevance: 4			
	Phase	*Role*	
A			[redacted]
B			[redacted]
C			[redacted]
D			[redacted]
E			[redacted]
F			[redacted]

Which are your top five info needs in each phase?

e.g. Tendering: product info, etc.
[redacted]

Who are the other players involved?

<u>Internal</u>			
Account Manager	Bid manager	Other	
System engineer	Customer Advocacy		
Sales engineer	Professional Services		

☐ Sales overlay			

External			
☐ Client		☐ Ecosystem partners	
☐ Other			

Who is the first person that you call when you have a technical problem proposing a competitive solution?

e.g. product line, product marketing, etc

How do you collect all the required information?

☐ Intranet	[redacted]	☐ Publications	[redacted]	
☐ Internet	[redacted]	☐ Other		[redacted]
☐ Colleagues	[redacted]			[redacted]
				[redacted]

How important are, in your opinion, complementary services and which of them are usually included in the proposal?

☐ Installation	[redacted]	☐ Billing	[redacted]	
☐ Maintenance	[redacted]	☐ Other		[redacted]
☐ Financing	[redacted]			[redacted]
☐ Training	[redacted]			[redacted]

Do your customers ask you for other services not currently available in Company I ?

[redacted]

During the offer, which are the most time-consuming activities?

	[redacted]
	[redacted]
	[redacted]

Selling strategy

Which are the main problems in composing a proposal that includesPBU products?

☐ Customer scouting	[redacted]	☐ Technical issues	[redacted]	☐ Communication with other		[redacted]
☐ Maintenance	[redacted]	☐ Training	[redacted]	☐ Other		[redacted]
						[redacted]
						[redacted]

What are the most important synergies between PBU and other Company I’s product sales?

[redacted]

Would you like further "integration" information for these products?

[redacted]

Web influence

How often do you use Company I intranet and for which purposes (excluding e-mail and Company I News)?

Frequency			
○ Very often (each day)	○ Once a day	○ Two or three times a week	○ Hardly ever

Purpose						
☐ Alias groups	[redacted]	☐ Market information	[redacted]	☐ Other		[redacted]

Product configuration	[redacted]	Technical issues	[redacted]			[redacted]
						[redacted]

Is it a useful tool for your job?

Yes [redacted]	No with the present configuration	Not at all

If you have any suggestion please give us

[redacted]

When you are looking for a document on the intranet, in which format would you like to find it?

Word (*.doc*)	Excel (*.xls*)	Power point (*.ppt*)	Acrobat (*.pdf*)	HTML	Other

Which optical aliases do you find more useful for your job?

Optical-interest	[redacted]	Beat-Lucent	[redacted]	SPMKT	[redacted]	
Ask-pbu	[redacted]	Optical-EMEA	[redacted]	SPMKTG	[redacted]	
Beat-Nortel	[redacted]	Optical-AP	[redacted]	PBU_Web	[redacted]	
Optical-J	[redacted]	Optical-LA	[redacted]	Other		[redacted]
ONT	[redacted]	Optical Insider	[redacted]			[redacted]

Looking at the future

Is it possible, in your opinion, to better support sales force using web tools and if yes what kind of tools would you prefer?

Personal support page	[redacted]	e-Mediate services (e-mail and chat)	[redacted]
Technical library	[redacted]	Winning proposal archive	[redacted]
Web-based training	[redacted]	Competitors information	[redacted]
Product news and events	[redacted]	Market/customer information	[redacted]
Support newsgroups	[redacted]	Proposal tool	[redacted]
BU visit organizer	[redacted]	Pricing tool	[redacted]

☐ Other		[redacted]		
		[redacted]		

Do you think that a virtual community on the intranet, in which is possible to share information and knowledge (in terms of experience) about successful sales, would help you in your job?

[redacted]

Think of an intranet portal dedicated to sales force support: for which issues would you like to find useful suggestions or solutions implemented by other accounts in similar situations?

[redacted]

Personal info

Give us some brief information about your background and your professional experience in Company I

[redacted]

How deep are your skills regarding thePBU products?

○ None	○ Some familiarities	○ Expert

In particular, give us info about your skills in:			
☐ Technical		[redacted]	[redacted]
☐ Competitive		[redacted]	[redacted]
☐ Theatre		[redacted]	[redacted]
☐ Other		[redacted]	[redacted]
		[redacted]	[redacted]

How deep are your technical skills about the others Optical BU's products?

Metro		
○ None	○ Some familiarities	○ Expert

Optical routers		
None	Some familiarities	Expert
Optical Management software		
None	Some familiarities	Expert

Submit Reset

Thank you again for your collaboration

We hope that our survey will produce useful results for all the sales forceteam!