

**TOWARDS RADICAL INNOVATION IN
KNOWLEDGE-INTENSIVE SERVICE FIRMS**

Anna van Poucke

PROMOTIECOMMISSIE

PROMOTOREN

Prof.dr. J.W.M. Kessels
Prof.ir.dr.s. W.J. Vrakking

OVERIGE LEDEN

Prof.dr. H.W. Volberda
Prof.dr. P.L. Meurs
Prof. J. Sundbo



311

R
5
00

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

1.	INTRODUCTION	1
1.1	CHARACTERISTICS OF KNOWLEDGE-INTENSIVE SERVICE FIRMS AND KNOWLEDGE SERVICE WORKERS	2
1.2	CONSEQUENCES FOR INNOVATIONS IN KISFS	4
1.3	CHARACTERISTICS OF INNOVATIONS IN KISFS: TOWARDS A DEFINITION	5
1.4	CONCLUSION	9
2.	INNOVATION IN KISFS: AN OVERVIEW OF APPROACHES	11
2.1	INNOVATION THEORIES	11
2.1.1	Levels of innovation	11
2.1.2	Innovative capabilities and strategies and technology capabilities and strategies	12
2.1.3	Models and phases in innovation	13
2.1.4	Organizational and managerial conditions	14
2.1.5	Conclusions	15
2.2	KNOWLEDGE CREATION AND KNOWLEDGE MANAGEMENT STRATEGIES	16
2.2.1	Types and levels of knowledge	16
2.2.2	Knowledge management strategies	17
2.2.3	New strategies: from epistemologies of possession to epistemologies of practice	19
2.2.4	Conclusions	20
2.3	ORGANIZATIONAL LEARNING AND LEARNING IN ORGANIZATIONS	20
2.3.1	The work on learning in organizations: some pitfalls	21
2.3.2	Levels of learning	23
2.3.3	Definitions of learning and approaches in learning	25
2.3.4	Coupling learning approaches to individual learning	33
2.3.5	Conclusions on learning in innovation	36
2.4	THE ROLE OF SOCIO-POLITICAL PROCESSES	36
2.5	ORGANIZATIONAL CONDITIONS AND THE ROLE OF MANAGEMENT	39
2.5.1	The role of management	39
2.5.2	Organizational conditions	39
2.5.3	Conclusions	41
3.	RESEARCH MODEL AND PROPOSITIONS	42
3.1	PROCESS OF AND PHASES IN INNOVATION: A RESEARCH MODEL	42
3.2	PROPOSITIONS	43
3.2.1	Propositions related to information processing and learning	44
3.2.2	Propositions related to socio-political processes	45
3.2.3	Propositions related to the role of management and organizational conditions	45
3.2.4	Rival propositions	45

4.	CASE STUDIES: GENERAL DESIGN AND METHODS	46
4.1	RESEARCH DESIGN	46
4.2	SELECTION OF THE CASES	50
4.3	DATA COLLECTION	51
4.4	CASE STUDY DATA BASE	53
4.5	DATA ANALYSIS	53
4.6	DEFINING THE VARIABLES	54
5.	RESULTS MEDICAL EDUCATION AND SOCIAL SCIENCES	59
5.1	RESULTS CASE MEDICAL EDUCATION	59
5.1.1	Case description	59
5.1.2	Within-site analysis case medical education	62
5.2	RESULTS CASE SOCIAL SCIENCES	67
5.2.1	Case description Social Sciences	67
5.2.2	Within-site analysis Social Sciences	70
5.3	CROSS-CASE ANALYSIS	74
6.	CONCLUSION AND DISCUSSION CASE STUDIES MEDICAL EDUCATION AND SOCIAL SCIENCES	76
6.1	CONCLUSIONS	76
6.1.1	Function and success of the innovation	76
6.1.2	Learning model	77
6.1.3	Information processing	78
6.1.4	Socio-political processes	78
6.1.5	Organizational conditions	79
6.2	FINDINGS RELATED TO PROPOSITIONS	80
6.3	DISCUSSION	83
6.3.1	Idea generation phase	84
6.3.2	Crystallization phase	85
6.3.3	Evolution phase	87
6.4	RESEARCH MODEL AND PROPOSITIONS REVISITED	88
7.	RESULTS CASE STUDIES	91
7.1	PROPOSITIONS AND VARIABLES REVISITED	91
7.2	RESULTS CASE PIG CITY	92
7.2.1	Case description Pig City	92
7.2.2	Within-Site analysis case Pig City	96
7.3	RESULTS CASE LITE CITY	107
7.3.1	Case description Lite City	107
7.3.2	Within-Site analysis case Lite City	110
7.4	CROSS-SITE CROSS-CASE ANALYSIS	120
7.4.1	Cross-site cross-case display per phase	120
7.4.2	Cross-site cross-case analysis of the innovation process	124

8.	CONCLUSION AND DISCUSSION CROSS-SITE CROSS-CASE ANALYSIS	129
8.1	CONCLUSIONS	129
8.1.1	Success and function of the innovation	130
8.1.2	Phases in the innovation process	131
8.1.3	Core concept	133
8.1.4	Earning model	134
8.1.5	Information processing activities	137
8.1.6	Socio-political processes	139
8.1.7	Organizational conditions	143
8.2	FINDINGS RELATED TO THE PROPOSITIONS	144
9.	TOWARDS A PROCESS DESIGN MODEL FOR RADICAL INNOVATIONS	150
9.1	CONDITIONS	150
9.2	DEVELOPING PRACTICAL DESIGN COMPONENTS	151
9.2.1	The innovative process	151
9.2.2	Idea generation phase	153
9.2.3	Crystallization phase	155
9.2.4	Evolution phase	158
10.	CASE STUDY PHARMACY: PROCEEDINGS AND RESULTS	161
10.1	PROCEEDINGS	161
10.1.1	Variables	161
10.1.2	Data collection and data analysis	162
10.2	CASE DESCRIPTION PHARMACY: CURRICULUM RENEWAL	163
10.3	WITHIN-SITE ANALYSIS CASE PHARMACY	167
11.	CONCLUSIONS CASE STUDY PHARMACY	181
11.1	CONCLUSIONS	181
11.1.1	Radical innovations: success and function of the innovation	181
11.1.2	Adequate application of the process design model	182
11.1.3	Actors	184
11.1.4	Core concept	185
11.1.5	Learning model	186
11.1.6	Information processing	187
11.1.7	Socio-political processes	189
11.1.8	Organizational conditions	190
11.2	FINDINGS RELATED TO THE PROCESS DESIGN MODEL AND PROPOSITIONS	190
11.2.1	General practical design components	190
11.2.2	Practical design components for the idea generation phase	192
11.2.3	Practical design component for the crystallization phase	193
11.2.4	Practical design components for the evolution phase	195
11.3	METHODOLOGICAL CONSIDERATIONS AND LIMITATIONS TO THIS STUDY	197
11.4	ANSWERS TO THE RESEARCH QUESTIONS	199

12. DISCUSSION: A REFINED DESIGN MODEL FOR RADICAL INNOVATIONS IN KISFS	204
12.1 REFINED PROCESS DESIGN MODEL FOR RADICAL INNOVATIONS IN KISFS I	204
12.2 INNOVATION IN KISFS AND INNOVATION IN GENERAL	207
12.2.1 Relevance of general innovation theories for KISFs	207
12.2.2 Relevance of the process design model for other types of organizations	208
12.2.3 Relevance of the process design model for other types of innovations	208
12.3 INNOVATION, CHANGE MANAGEMENT AND KNOWLEDGE ECONOMIES	209
12.3.1 Innovation as change management	209
12.3.2 Innovation as knowledge economics: strategic competitiveness	212
12.3.3 Final process design model for radical innovation in KISFs II	217
12.4 DESIGNING FOR RADICAL INNOVATIONS: APPLYING THE MODEL	217
12.4.1 Idea generation	217
12.4.2 Crystallization	223
12.4.3 Evolution	229
12.4.4 Management and organizational conditions	230
12.5 SUGGESTIONS FOR FURTHER RESEARCH	234
REFERENCES	236
APPENDICES	244
Appendix I Criteria for preliminary determination of radical vs incremental innovation	244
Appendix II Data collection protocol	245
Appendix III Questionnaire part 1	247
Appendix IV Outline for case description	251
Appendix V Definition list of codes	252
Appendix VI Transfer of codes into within-site data matrixes	256
Appendix VII Within-side data displays case 1	258
Appendix VIII Questionnaire part 2	264
SUMMARY	267
SAMENVATTING	276
ABOUT THE AUTHOR	286

ACKNOWLEDGEMENTS

In 1986 I started my working life as an employee in a knowledge-intensive service firm. From the first moment I was intrigued by the strong motivation of knowledge workers, their craving for autonomy and the politics between them. Having spent time in different knowledge-intensive service firms I began to wonder why some organizations were successful in transforming their potential in new products and services while others were not. This puzzlement was the start of a Ph.D. project leading to this dissertation. I considered it a luxury to explore and reflect on a subject that proved to be so interesting. However, this luxury and its results would not have been possible without the support from a number of people.

In the first place I want to thank Willem Vrakking and Joseph Kessels who supervised this project. They proved to be a very complementary team providing new viewpoints, methodological thoroughness, the freedom to explore, and professional and emotional wisdom whenever necessary. It was a privilege and pleasure to work with them.

Jurian Muller assisted in the research of the second part of this study. His enthusiasm and willingness to challenge my ideas provided an improvement to the final model. Members of the Ph.D-network on Knowledge and Learning in Organizations offered suggestions and methodological support.

Many colleagues and clients contributed to my professional development and this Ph.D. dissertation. Some of them had a special role by providing me with ideas, contacts and the means to perform this project. For this I want to thank Hanneke Mulder, Fried Keesen, Jan Willem Brinkman and Ton de Leeuw.

A number of persons and institutions contributed to the case studies. I want to thank them all: members of the Utrecht University Faculties of Medicine, Social Sciences and Pharmacy, and members of MVRDV. I want to thank Winny Maas, Olle ten Cate, Gerard Visser and Ton de Boer for their thought provoking interviews. Special thanks go to the members of the CURC for adopting me as one of them and showing me what professional commitment and innovation is really about.

This dissertation would not have been realized without the vigorous help of two splendid people: Candy Rudmose and Harriët Dröge. Candy did an enormous job in correcting all the English. Harriët edited this dissertation: never a table again!

I also wish to express my love and gratitude to my family and friends. My 'paranimfs' Peter and Hanke for their friendship and the role they played in my professional development. My family and friends for believing in me and especially Hans and Miep van Poucke for the support and opportunities they provided me with in life.

Barend and Margriet were my muses in showing me every day how intriguing learning and discovery is. My final word is for Frans, who convinced me of my need to write this dissertation and who stood by me in all the difficult moments: dank, mijn lief.

Anna van Poucke

Doorn, november 2004



1. INTRODUCTION

What is happening in the field of knowledge-intensive work and professional services? Why do knowledge workers have to work harder to prove their added value and significance on the basis of the knowledge they hold?

Due to globalization and explosive growth in the use of information technology and media, professional and complex knowledge is becoming increasingly rapidly and widely available (Stewart, 1997; Davenport and Prusak, 2000; Teece, 2000). As a consequence, not only is competition between knowledge firms increasing, but, even more important, knowledge gaps between clients and specialists are being greatly reduced. It is getting harder and harder for knowledge firms and their workers to prove their surplus value (Dougherty 2000). Time-life-cycles of knowledge and knowledge-related products and services are decreasing (Nonaka and Takeuchi, 1995; Wegge-man, 1997). While this may be a danger in itself to all sorts of firms (Schilling and Hill, 1998), the danger of losing added value in terms of applied knowledge is even greater for knowledge-intensive service firms (KISFs), as the core product of these firms lies in the production and transfer of this knowledge (Coombs, 1999). Losing the added value of knowledge 'offered' to clients for KISFs means losing competitive advantage in terms of their core product. In order to retain their competitive advantage, KISFs have to replace the value of possessing knowledge by the value of innovation and movement (Dougherty, 2000). Core-competences of professionals and knowledge workers will have to change from the ability to acquire and highly effectively, apply knowledge into 'the ability to assimilate new ideas and to transfer those ideas to action faster than a competitor' (Ulrich et al., 1993). KISFs will have to start to develop innovative capabilities (Dodgson, 1993; Teece and Pissano, 1994).

These developments have been recognised by most knowledge-intensive firms, but the realisation of this creative and innovative process is not easy for KISFs. As we will argue in this study, the creation, distribution and leverage of newly developed knowledge is often hampered by the nature of the primary processes of KISFs (Moore and Birkinshaw, 1998; Dougherty, 2000). This means that KISFs suffer from a strong and fundamental contradiction: creation and leverage of new knowledge is becoming more and more their core-competition, while at the same time the primary process of the organization impedes this process.

Due to the differences between distribution of companies in the manufacturing and the services industry, innovation has mostly been studied in the manufacturing industry (Den Hertog et al., 2003). On this basis theories of innovation are developed (Sundbo, 1997; Muller, 2004). It is, however, not obvious that innovation concepts developed in the manufacturing industry, can be applied to services (and especially knowledge-intensive services) as well (Sundbo and Gallouj, 1998). In spite of increasing research efforts on KISFs in general (Wong and He, 2002), there is still little research on innovation within these firms (Coombs, 1999). So while the need for insight concerning the issue of knowledge creation and innovation for KISFs is high, there is only a small body of research to tap. This study is an attempt to contribute to the body of knowledge on innovation in KISFs.

The first part of this study is descriptive in character: on the basis of an extensive literature study and four subsequent case studies of innovation processes in KISFs, general principles of the

process of radical innovations in KISFs are distilled (part 1). The second part aims at the development of a process design model for innovation: on the basis of the findings in part 1 a process design model is developed, which is subsequently applied to the development of a radical innovation in a KISF. On the basis of this application the model is evaluated and enhanced (part 2). Part 2 is more prescriptive in character, yet does not pretend to give an algorithmic prescription for the process of radical innovation. The process design model that is developed presents heuristic statements that can be used as guidelines in the creation of radical innovations in KISFs.

1.1 CHARACTERISTICS OF KNOWLEDGE-INTENSIVE SERVICE FIRMS AND KNOWLEDGE SERVICE WORKERS

In the 20th century service industries have rapidly increased in terms of their share in GDP and employment and in their contribution to economic growth (Den Hertog et al., 2003). Although a number of these firms deliver more or less routine services that require relatively small knowledge bases (e.g. retail trade, hotels and restaurants), a substantial part of the service firms deliver complex and non-routine services that require large knowledge bases and complex processing of this knowledge. The latter are described as knowledge-intensive service firms (KISFs). Due to the still rising importance of knowledge in the economy (Drucker, 1988) the share of KISFs in our society is becoming more and more dominant.

There are a number of different definitions of KISFs. Overlapping elements in these definitions are:

- Performing, mainly for other firms, services encompassing high intellectual and value-added knowledge (Muller, 1999).
- Companies relying heavily on professional knowledge i.e. knowledge or expertise related to a specific (technical) discipline or (technical) functional domain supplying intermediate products and services that are knowledge-based (Bilderbeek et al., 1998; Windrum and Tomlinson, 1999; Den Hertog, 2000).

We want to distinguish the knowledge-intensive business services (KIB's) from KISFs, in that KISFs can also deliver services to individual clients and are, in contrast to KIB's, not only private but also public in character. By broadening the range of knowledge-intensive firms in this study to both private and public, we feel we increase the number of insights and experiences we can tap. As such we use a somewhat broader definition of KISFs:

Firms that provide services to clients, where these services are based on knowledge that is complex and non-routine in character and where well-educated, qualified employees form the major part of the workforce.

KISFs rely on the human capital *casu quo* the intellectual capital of their workforce. This workforce is often referred to as either professionals or knowledge workers. There is strictly speaking, a difference between professionals and knowledge workers, as professionals have a restricted access due to codes of ethics determined and guarded by professional associations, strong professional affiliations and specific educational requirements (Friedson, 1970; Realin, 1985). In the context of this study, however, we will use the terms professionals and knowledge workers interchangeably as both groups can be considered as 'disciplines', where 'a discipline is

a body of practice based in some underlying theory or understanding of the world, which suggests a path of development or education in its true sense of coming out' (Senge, 1990, pp. 10). In this sense the professional service firm (PSF) will also be considered as part of the somewhat larger collection of the KISF. When we use the term KISF, we include PSF's.

In the context of this study there is a major difference between regular knowledge workers and knowledge service workers, in the sense that knowledge service workers deliver their work in interaction with their users or clients. As such we distinguish KISFs from both traditional service firms (Coombs, 1999) that provide services based on non-complex and routine knowledge that is mostly stored in objectified systems (Dougherty, 2000) and from knowledge-intensive production firms that also use non-routine and complex knowledge, but provide their clients with tangible products (e.g. firms that produce complex hardware based on emerging technologies).

Examples of KISFs are law firms, accountancy practices, architectural practices but also universities, higher educational institutions, (university) hospitals and R&D organizations. The characteristics of KISFs mentioned in our definition (delivery of services and thus intangibility of the product, use of complex, non-routine and often individual knowledge, and a well-educated workforce) account for a number of characteristics in the primary process:

- The output of the work delivered is often unspecified: working with and developing knowledge in a highly intensive way, means having the ability to rely heavily on one's own insight and knowledge base and designing one's own procedures to realize the desired output (Van Poucke and Van Wijk, 1995).
- Specification of the output is often done during the process of delivery, in interaction with clients or users, or even on the bases of the proceedings during the process (Van Delden, 1992; Maister, 1997).
- The character of the work is rooted in the analysis, use and 'manipulation' of knowledge; it concerns problem-identifying and problem-solving activities in which knowledge is continuously adapted and developed (Stewart, 1997).
- Knowledge-intensive workers, more especially those who are considered as traditional professionals, are strongly concerned with protecting their professional autonomy and may find it hard to accept new technology that is imposed from outside (Coombs, 1999).
- Services are often delivered on client-location; as a consequence knowledge in practice is localised in teams or individuals and is not necessarily conferred to other areas in the firm (Moore and Birkinshaw, 1998; Coombs, 1999; Dougherty, 2000; Newell et al., 2002).

It is important to note that in terms of the first four characteristics a differentiation within the group of knowledge-intensive service workers can be made. These differences are strongly related to the nature of the knowledge used and to the amount of freedom available for specification of the output to be delivered. In terms of knowledge used, there is at one end of the continuum the knowledge worker who 'emphasizes knowledge which is embedded in techniques, rules and procedures' and at the other end of the continuum the knowledge worker who 'emphasizes knowledge which is embrained in the cognitive skills of individual analysts and encultured as shared or collective understandings' (Blackler, 1995, pp. 1029). These two groups can be referred to as R-professionals (routine professionals) and I-professionals (improvising profession-

als). Whereas R-professionals provide predefined services on the basis of structured knowledge applied at a high level of expertise, I-professionals produce new approaches on the basis of their professional knowledge and their creative and improvisational abilities (Weggeman, 1992). In general, the position of the knowledge worker on the continuum between routine and improvisation determines the needed room for manoeuvre in performance of the primary process. The more 'embrained' or improvisational the service work is, the less possible it is to specify output beforehand. Specification of output will take place during the delivery process, demanding room for the use of available insights and knowledge and room for interaction with the client.

One other salient characteristic of the KISF is the highly socio-political character of the firm. This is due to the work process, the character of the knowledge worker (Raelin, 1991) and the structure (Mintzberg, 1979) of the firm. As a result of the high amount of autonomy in his work, the professional determines his own position and self defined strategy in terms of improvement of competitive position (Weggeman, 1992) and develops an aversion towards directions imposed by management (Maister, 1993). In terms of the character of the knowledge worker, the role and presentation towards the client as an expert requires self confidence and mastery (Raelin, 1991). This self-conscious attitude is taken along to the KISF and encourages the knowledge worker to belief that no decision can be made without his or her input (Maister, 1993). The preferred organizational structure of adhocracy leads to (dynamic) control based on professionalism rather than on hierarchy and adherence to rules and procedures. From different research projects (Van Poucke and Van Wijk, 1995; Otto and Van Poucke, 1992) it appears that decision-making processes in professional service firms are not determined by hierarchical and rational processes, but are determined by the existence of different coalitions, the power balances between these coalitions, and the negotiation processes between the coalitions. In these socio-political decision-making processes the role of the professionals is a dominant one. In general the dominant pattern of management and governance in a KISF can be characterised as a 'social arena' (Morgan, 1986). Eygenraam (1995) found that these characteristics of the social arena were stronger for professional service firms that were populated by I-professionals than for professional service firms populated by R-professionals.

1.2 CONSEQUENCES FOR INNOVATIONS IN KISFS

The previously mentioned characteristics that are essential to knowledge-intensive service work both facilitate and hamper the creation and implementation of innovations in KISFs:

- The specification of output and procedures during the work process gives room for continuous improvement and re-invention of applied knowledge and methods (Rogers, 1995). In this sense innovation is facilitated.
- The specification of output and procedures, especially in interaction with the client or users, demands a large amount of autonomy for the knowledge-intensive worker in his work. As a consequence it is difficult to impose innovation and implementation from outside (outside meaning either imported external innovation, hierarchically imposed innovation or imposed innovations developed by other professionals not belonging to the dominant coalition).
- In line with this the socio-political character of the KISF further impedes implementation of innovations and/or leverage of internally developed innovations.

- As services are often provided on ‘client-location’ and the work is solitary in character (be it ‘individual’ or ‘team-solitary’), other workers or management have little insight into the work-process and output. As a consequence:
 - Developed innovations are not easily available to other workers or management, thus reducing leverage of innovations and newly created knowledge.
 - Individuals or teams form the main entry of the firm to the market (or market segment) and are the sole connection to the *in situ* developments taking place in these markets (Moore and Birkinshaw, 1998). This may lead to a lack of insight into strategic market developments and subsequently necessary innovations.

In general the characteristics of knowledge-intensive service work provide positive conditions for the development of new knowledge and small innovations restricted to (small groups of) individual knowledge workers (Stewart, 1997), but negative conditions for the development of more general new client and service strategies and more fundamental innovations or ‘structural capital’ available to the firm at large (Van Poucke and Van Wijk, 1995; Stewart, 1997; Coombs, 1999).

The negative conditions for the creation of more fundamental innovations in connection with the increased need for the ability to assimilate new ideas and to transfer those ideas to action faster than a competitor may lead to major problems for KISFs in the coming years.

As a consequence of the described characteristics of knowledge-intensive service work and the changes and developments for KISFs, KISFs themselves have two important strategic issues to address in the coming years:

- a. How can state-of-the art and highly complex innovation as an inherent part of professional and knowledge work be realized?
- b. How can these innovations be synthesized, generalized and implemented in such a way that optimal leverage is realized and strategic competitiveness is gained?

This research aims at finding approaches to deal with these problems. From the two issues mentioned above the following central question for this research project can be formulated:

What processes lead to the creation and use of innovations that realize strategic competitiveness for KISFs?

1.3 CHARACTERISTICS OF INNOVATIONS IN KISFs: TOWARDS A DEFINITION

Before we elaborate on the processes that underlie the creation of innovation, it is essential to clarify what we mean by innovation in a KISF. There are many different explicit and implicit definitions of innovation and in these definitions the concept of innovation is often blurred with other concepts. In recent publications the concept of innovation is interchangeably used with learning (Senge, 1990; Nonaka and Takeuchi, 1995; Coombs, 1999; von Krogh et al. 2000), the creation of knowledge (Weggeman, 1997; Robinson and Stern, 1997; Coombs, 1999, Von Krogh et al. 2000), or creativity (Robinson and Stern, 1997; Wenger, 1998). This ‘mingling’ of concepts makes it more difficult to analyse what the underlying processes that lead to innova-

tions, are. On the one hand the intermingling of concepts makes it difficult to distinguish between the underlying processes and the output of these processes. On the other hand the intermingling of concepts seems to assume implicitly that learning, knowledge creation and innovation are related, and even more that one may lead to the other. But we cannot be sure that when we are studying learning, creativity or knowledge-creation we are at the same time studying the creation of innovations (this is further elaborated in chapter 2).

In order to study the creation of innovations, we consider innovation as a (temporary) 'end state' of the innovative process. By temporary we refer to the fact that innovations are often 'states' that develop further by means of adaptation, improvement and re-invention (Rogers, 1995; Robinson and Stern, 1997). When we want to obtain insights in the underlying processes that lead to the creation of innovations, we will have to start by stating what we mean by innovation in the context of the KISF.

In the definition and description of innovations a number of its characteristics are based on: the process of innovation (e.g. Senge, 1990; Nonaka and Takeuchi, 1995; Weggeman, 1997; Von Krogh et al. 2000), the amount of newness in the 'endproduct' (Rogers, 1995; Stewart, 1997), the contents of the 'product' (Leonard-Barton, 1995; Burgelman et al, 1996); competences of the organization (Hamel and Prahalad, 1990) or its function in terms of strategic or competitive position (Pinchot, 1985; Vrakking, 1992; Burgelman et al, 1996). A problem that often occurs in the research that is being done on innovation is created by the fact that it is not made clear which characteristic of innovation is chosen. This reduces the external validity (Yin, 1994) of these research projects and calls for the necessity to base research on innovation on a proper definition of the subject of study.

We want to define innovations in KISFs on the basis of two relevant dimensions: the characteristics of the innovation and the functionality of the innovation.

Characteristics

One important characteristic of innovation is its relative amount of newness. Although the amount of newness is often used in defining whether something is considered an innovation (e.g. Vrakking, 1992; Rogers, 1995; Robinson and Stern, 1997; Stewart, 1997), it may be hard to define the actual amount of newness in an innovation. This difficulty may be even stronger in innovations in the services industry than in innovations in manufacturing, due to the intangibility of services (Coombs, 1999). Whereas it may be quite straightforward to point out the novelty of a tangible product, it may be much harder to determine the novelty in a service. In services a new combination of service innovations that already exist on their own can still emerge as an innovation elsewhere (Gallouj and Weinstein, 1997). In essence the actual (knowledge-intensive) service is created at the moment of delivery in interaction between provider and client. Part of the newness will be determined by (the unique) interaction between provider and client. Rogers (1995) mentions in this context the amount of software information in an innovation. The software aspects of an innovation point to its properties in terms of (abstract) concepts and its possibilities for heterogeneous (areas of) application (Rogers, 1995). Especially in the knowledge-intensive service industry, innovations will largely if not totally consist of software-components. Den Hertog (2003) mentions in this context the dominance of three aspects of non-technological innovation in services: introduction of a new service concept, a new client interface and a new service delivery system. Where innovation at the level of the firm may be dominantly concept

based, this concept innovation may be mixed with innovative client interfaces at the level of delivery. Innovations in knowledge-intensive services thus leave room for or are even intended to have heterogeneous possibilities for application. As a consequence the process of application (or implementation) of the innovation is a continuous process of re-invention and incremental innovation (Rogers, 1995) leading to continually evolving products (Coombs, 1999). This makes it difficult to identify an innovation in terms of a 'steady end state', but also makes it difficult to point out what the amount of newness in the innovation is. As such it will be difficult to base a definition of innovation in KISFs on the relative amount of its newness. Instead of defining innovations in terms of their newness we want to focus on the essence of an innovation in its contribution towards the competitive position of the firm in the future.

Function and contingency of innovations

The contribution of the innovation towards the competitive position (the strategic effect) is determined by both the content of the innovation and the (intended) strategic position of the firm. In terms of strategic effect, the major distinction is between innovations that lead to improvements within existing strategic frames and innovations that lead to new strategic frames (e.g. Henderson and Clark, 1990; Burgelman et al, 1996; Von Krogh et al, 2000; Teece, 2000; Davenport and Prusack, 2000). We want to refine this basic distinction by defining four types of innovations on the bases of content and effect:

- *Incremental innovations* are alterations to existing products that lead to improvements in content or in efficiency (Volberda, 1990; Brown and Duguid, 1991; Burgelman et al, 1996). Existing capabilities of established organizations are reinforced; existing market situations are improved (Henderson and Clark, 1990). These innovations are linear and continuous in character (Community Intelligence, 2003)
- *Strategic innovations* are fundamental renewals of existing applications or new services based on new concepts and/or technologies or new combinations of concepts and/or technologies that provide for an enduring competitive position by either extending existing markets or by opening up of new markets (Clark, 1987; Henderson and Clark, 1990; Volberda 1990).
- *Radical innovations* are mostly, but not always (Burgelman, 1996), based on not yet used sets of engineering and scientific principles and often open up new markets and potential applications (Henderson and Clark, 1990; Rogers, 1995). They are non-linear and are a discontinuity of the existing line (Community Intelligence, 2003).
- *Architectural innovations* are in essence reconfigurations of established systems that link together existing components in a new way where the result mostly leads to new and improved production processes (Henderson and Clark, 1990; Volberda, 1990).

In our view the difference between strategic innovations and radical innovations is more gradual than fundamental. Both types of innovations seem to rely on fundamental shifts in underlying concepts or technologies and are in essence technology driven (whereas incremental innovations seem to be in essence client or market driven). If there is a difference between strategic and radical innovations, this difference lies in the perceived amount of paradigm shift in terms of underlying concepts and technologies. Because the difference between the two types of innovation is gradual rather than fundamental, we will in the context of this study treat these two types of innovations as one, labelling them as radical innovations.

It is stated that the dichotomy between incremental and radical innovations may be too simple (Den Hertog, 2003): most innovations are a mixture of major and minor changes and adaptations (Bilderbeek et al., 1998) and it gives no credit to the more complex character of innovations (client or supplier driven, developed in the firm or with the client). In our view, however, the rather simple dichotomy between radical and incremental innovations can be a solid starting point for our research into the processes that take place.

As we stated the value of an innovation is not only determined by the content and effect of the innovation itself. The value is also determined by the strategic position and strategic intent of the firm. Maister (1993) used a classification of professional service firms that is related to their strategic function and position:

- The *expertise-based firm* serves clients with frontier problems: large, complex, high-risk and unusual problems, which demand non-routine, highly innovative and customized approaches.
- The *experience-based firm* serves clients with rather complex, high- to-medium-risk problems, which are not new in the field or of an unusual character. These problems ask for specific and fine-tuned customization of proven approaches.
- The *efficiency-based firm* serves clients with problems that are not new. The approach needed is based on widely available competences and is valued for its low costs, for a proper customization and focus on client needs.

The efficiency based professional service firm is also referred to as the mass production service firm, while the expertise-based firm and the experience-based firm are referred to as 'real' KISFs (Coombs, 1999; Dougherty, 2000). Whereas efficiency-based firms seem to rely on architectural innovations for maintaining their strategic position (efficiency improvement in the delivery process, development of commodity packages and combinations of existing modules), the experience- and expertise-based firms rely for their long term survival on innovations that are related to the knowledge contents of services provided.

Research shows that different types of KISFs rely on different types of knowledge strategies and subsequent innovation output. Experience firms rely on modularization and customization of approaches and concepts and stress leverage rather than innovation in itself. Expertise firms stress the importance of the ability to co-create new knowledge on the basis of experience and client needs (Hansen et al., 1999). This stresses the importance of knowledge creation processes rather than knowledge leverage processes in the generation of innovations by these firms. Based on the four types of innovations we defined, it seems that experience firms rely on incremental innovations in order to provide fine-tuned and 'experience based approaches' towards complex situations. Expertise firms rely on more radical innovations to provide clients with novel approaches for frontier and complex problems. These findings lead to a contingency model for innovation that is based on matching levels of innovation with function and position of the firm.

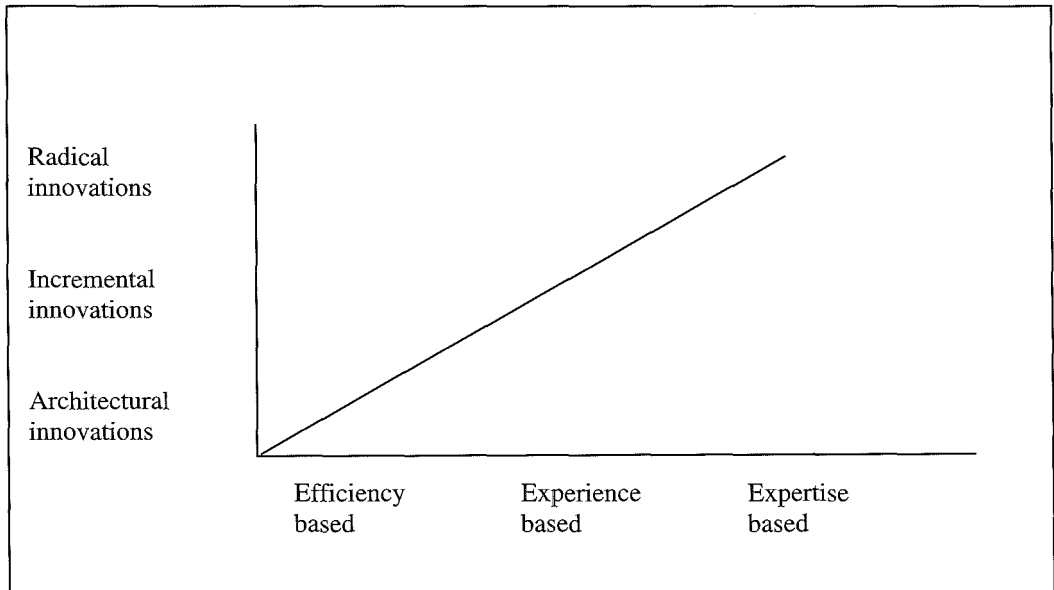


Figure 1: contingency model of innovation

1.4 CONCLUSION

We have argued that the relative amount of newness is hard to define for innovations in KISFs, and the real value of an innovation lies not so much in its amount of newness, but rather in the value it provides by matching content and strategic position (be it maintaining an existing strategic position or gaining a new strategic position). In reference to this we want to base our definition of innovation on this last aspect. For the purposes of this study we use a variation on Vrakking's (1992) definition of innovations:

“Every renewal that is designed [as well as realized], through which the position of the KISF as compared to competitors, is strengthened in such a way that also on a longer term a competitive advantage can be retained”

In focussing on innovations in KISFs, we will look into incremental and radical innovations, rather than architectural innovations. In our view architectural innovations may be interesting, but are more relevant to efficiency firms in constituting products on the basis of redeployment of existing modules or in realizing efficiency gains in the delivery process (Henderson and Clark, 1990).

The question can be asked whether the underlying processes in incremental and radical innovations are fundamentally different (Burgelman, 1983) or are characterised by variations that lie on the same continuum. In some studies the presumption is made that a number of incremental innovations will automatically lead to radical innovations (Gieskes, 2001). This is an assumption that is worth studying. As stated before, the delivery of knowledge-intensive services is very susceptible to re-invention (Rogers, 1995) and as such the creation of incremental innovations

can be considered as part of the daily work-process of KISFs (Brown and Duguid, 1991). As we are interested not so much in the daily work- processes of KISFs but in the actual processes that lead to innovation, we want to reformulate our central research question:

What are the processes that lead to the creation and implementation of radical innovations in KISFs?

In chapter two we will, on the basis of a literature study, develop a model to address our research question in detail.

2. INNOVATION IN KISFS: AN OVERVIEW OF APPROACHES

As stated in chapter 1, there is a large amount of research into innovation in the manufacturing industry, but the applicability of this research to KISFs is not obvious (Sundbo and Gallouj, 1998). Since there is little research into innovation in KISFs, we choose to approach the issue in an eclectic way: our literature study is based in a number of fields that are related to innovation and that may provide us with useful insights.

In 2.1 we start with a discussion of relevant insights from the more ‘classical literature’ on innovation, we focus on the different levels of innovation related to strategic levels, the phases and process of innovation and facilitating factors and the applicability of these insights to KISFs. In 2.2 we give an overview of insights and viewpoints from the recent literature on knowledge management and knowledge creation; we focus on descriptions of types of knowledge and strategies for knowledge management, and discuss the usefulness of this literature for innovation in KISFs. In 2.3 we look at the literature on learning in organizations and learning organizations, we discuss the different streams in this literature, levels of learning, the learning process and the usefulness of the discussed approaches for innovation in KISFs. In 2.4 we look at the socio-political factors that may play a role in the creation and implementation of innovation in KISFs. In 2.5 we give an overview of literature on organizational conditions and the role of management in innovation. The contents of chapter 2 form the basis for the development of a theoretical framework and propositions for studying innovation in KISFs, as developed in chapter 3.

2.1 INNOVATION THEORIES

The body of literature on innovation in general is very rich and encompasses a whole range of different aspects of innovation and implementation. As most of the literature is based on innovation in the manufacturing industry, we want to restrict the treatment of subjects in this context to those that have a relevance to innovation in knowledge-intensive services.

For our treatment of the subject there are four relevant themes in literature on innovation:

- The level of innovation.
- The existence of and relation between innovative capabilities and innovative strategy, and technological capabilities and technology strategy.
- The phases in the process of innovation.
- General facilitative factors in innovation.

2.1.1 Levels of innovation

In line with the distinction made in paragraph 1.3, innovations can be divided into those remaining within existing strategic frames of reference and those that create new strategic frames of reference. The distinction can be placed on a timescale in terms of more short-term survival strategies in optimizing existing markets or more long-term advancement strategies (Von Krogh et al., 2000) by realizing new market segments for the organization. The distinction in terms of strategic frames of reference can be directly related to incremental innovations (survival strategies taking place within existing frames of reference) and radical innovations (advancement

strategies that are related to new frames of reference). In general service firms (including KISFs) have been classified categorically as supplier-dominated, suggesting that most service firms have no autonomous innovation function. Recent research (see Den Hertog (2003) for an overview) pointed out, however, that the majority of service firms do actually have an autonomous innovation function. This means that innovation in KISFs can be both aimed towards survival strategies and towards advancement strategies.

2.1.2 Innovative capabilities and strategies, and technology capabilities and strategies

In the innovation literature the processes leading to innovations are based on innovative capabilities, innovative strategies and technology capabilities and strategies. Burgelman et al., (1996) define the innovation process as a result of both *innovative capabilities* and *innovative strategies*, where “*innovative capabilities are the comprehensive set of characteristics of an organization that facilitate and support innovative strategies*” (Burgelman et al., 1996, pp. 8). Innovative strategies in turn are determined by the resources available for innovative activity, the capacity to understand competitors’ innovative strategies and industry evolution, the understanding of the own technological environment and the implementation of both structural and cultural contexts for innovation and the implementation of strategic management capacity for innovation. In general the innovative capacity of a firm is based on:

- Innovative strategy as related to competitors and to the context of the relevant sector of industry.
- Technological capabilities and strategies.
- Resource management.
- More general strategic management and capacity management.
- Structural and cultural context.

Technology capabilities and strategies are influenced by:

- Internal (R&D) and external technology sourcing (Burgelman, 1983; Walz and Bertels, 1995).
- Managing technology push versus market pull (Burgelman, 1983; Volberda, 1990; Van der Hart and De Vries, 1992).
- The use of technology in technological support activities and, more specifically, management of the interaction between expert knowledge from developers and field users (Burgelman, 1983; Tushman and Rosenkopf, 1992; Walz and Bertels, 1995).

From research it appears that there is a difference between incremental and radical innovations in terms of the deployment of innovative strategies and use of technology capabilities and strategies. Incremental innovation is based on *induced strategic behaviour* that relates innovative actions to familiar external environments and is aimed at keeping strategic behaviour at operational levels in line with current strategies. Innovations are aimed at survival or at optimizing current strategies (Burgelman, 1983; Von Krogh et al., 2000). Field users will play a strong role in determining the contents of subsequent innovations (market pull driven technologies). New technological paradigms are not brought into the process. Incremental innovations are based on existing dominant technological designs (Tushman and Rosenkopf, 1992).

Radical innovations are based on *autonomous strategic behaviour* where the organizations environment is redefined and where innovative strategies are focused on entrepreneurial rather than optimisation activities (Burgelman, 1983; Teece, 2000; Von Krogh et al, 2000). These entrepreneurial activities tend to explore the boundaries of the firm and the firms competences (Burgelman, 1983; Ulrich et al, 1993). Technology strategies in these situations have a stronger tendency toward external technology sourcing (technology push driven). As such the strategic process is guided by *strategic recognition capacity* (explorative capacity) of top and senior management rather than by *strategic planning capacity* (exploitative capacity) (Burgelman, 1983; Cohen and Levinthal, 1990). Radical innovations are mostly based on new technological paradigms (Tushman and Anderson, 1986; Burgelman, 1996).

Although the distinction between levels of innovations is considered to be important in the literature on innovation, it is remarkable to note that this distinction has, until now, not been extensively researched in terms of differences in the underlying processes (some exceptions are the work by Tushman and Anderson (1986) on technological discontinuities and organizational environments, and some work by Walz and Bertels (1995) in which they describe the types of the '*adaptive mitarbeiter*' and the '*innovativer mitarbeiter*'). Since our research question is aimed at describing processes that underlie radical innovations in KISFs, this lack of research poses another problem. There is little research on innovations in KISFs to tap, but there is also little research focused on radical innovation. This means that our research cannot be aimed at testing of hypotheses deduced from an existing body of research, but is highly deductive and will be aimed at finding answers to 'embryonal research questions'. In order to develop these questions we shall consider other aspects of the general literature on innovation that are related to the differences between incremental and radical innovations.

2.1.3 Models and phases in innovation

As stated, there are different processes that lead to the creation of incremental and radical innovations. This difference is also reflected in the different models that describe the phases in the innovation process:

- Models based on *paradigm shifts* in innovation: describing the phases in development of new technological systems and approaches that function as a basis for innovations: technological discontinuities, followed by a period of technological ferment, the appearance of a dominant design, followed by periods of incremental change, and then the re-start of a period of technological uncertainty and discontinuity (Tushman and Rosenkopf, 1992).
- Models based on *continuous forms* of innovation: describing innovation as a result of interactive and sequential processes of invention and discovery (tinkering, research and development) and technological innovation (market development, product and process development, developmental activity) (Burgelman et al, 1996).
- Models that describe the *innovation process in general*, regardless of the more radical or incremental character of the innovation: describing the innovative process as successive steps leading to implemented innovation. An innovative phase consisting of research, development, decision-making and dissemination is followed by the implementation phase which is realised by implementation, evaluation and correction (Vracking and Cozijnsen, 1992; von Krogh et al, 2000).

For our study especially the first and third types of models are interesting. In the models related to creation of radical innovation, the technological process and/or the strategic process are important influential elements. Tushman and Rosenkopf (1992), point to differences in the processes of development of new technological systems. The emergence of a new dominant design as a basis for radical innovation is driven by 'socio-political' dynamics and played out between competing organizations, practitioner communities, suppliers, vendors and customers. The emergence of new dominant designs (and radical innovations) initiate eras of incremental, puzzle-solving technological progress. This latter incremental process '*is driven by logic internal to the technology and the institutional momentum in the community of practitioners*' (pp. 329). It can be concluded that radical innovations depend on processes related to both technological processes and socio-political processes that involve different organizations and stakeholders, while incremental innovations are determined by technological and logical processes based within the organization. Both the locus of and the process of acceptance and development of incremental and radical innovations seems to be fundamentally different.

The postulation rooted in research on innovation in manufacturing, that radical innovation relies on the emergence of new dominant designs, is contradicted by the postulation in some research in the intensive knowledge sector, where it is assumed that radical innovations are the result of continuous incremental innovation (Coombs, 1999) or where incremental innovation is seen as *the* mode for innovation (Brown and Duguid, 1991; Cook and Brown, 1999). This difference is related both to the character of the innovation (the technological process) in KISFs and the socio-political processes in KISFs. In many KISFs the professionals are not only deliverers of the services provided, but are also the co-designers of these services. This is due both to the high software component of the services and to the necessary amount of fine-tuning in delivery to the client. It can even be stated that in expertise firms, the (team of) professionals who deliver the service are the innovators of new products. As a consequence it was assumed for a long time that in the service-industry innovation was dominantly client-led, suggesting that most services firms do not have an autonomous innovation function. Only recently it has become clear that the most frequently occurring pattern for innovation in services is autonomous innovation (Den Hertog et al., 2003). This gives a more dominant role to new technology. However, this insight does not necessarily imply that innovation in KISFs has a more radical than incremental character. The ability to innovate radically is not only determined by the importation of new technology; other factors like culture, resources management and strategic capacity, also play a role. As stated in chapter 1, the socio-political character of KISFs can be especially detrimental to the importation and acceptance of new technology, thereby hampering (radical) innovation. We will elaborate on this in paragraph 2.5.

In terms of the level of innovation, the role of technology and different models, we want to conclude by stating that innovation in KISFs is (also) autonomous and based on new technology. This means that the phases for innovation as described in the paradigm-shift models and the general-innovation models are relevant to innovation in KISFs.

2.1.4 Organizational and managerial conditions

The last element from the research body on innovation in general, that is relevant for our study is the existence of facilitating conditions for innovation in the organisation. In the context of this study we will give only a short overview of existing insights from studies on this subject. From

research it appears that organizational and managerial conditions that have an influence on innovation can be divided into two categories: conditions related to stability and conditions related to rapid change (Maidique and Hayes, 1984). From research it appears that the innovative process is influenced by:

- Strategy related conditions: business focus, relevance to corporate objectives and a production orientation.
- Structure and procedure-related conditions: organisational cohesion, project selection and evaluation systems and systems of effective project-management and control.
- Style and staff related conditions: adaptability, market orientation and the source of creative ideas.
- Culture related conditions: an entrepreneurial culture, an organization receptive to innovation and hands on top management and commitment (Maidique and Hayes, 1984; Twiss, 1995).

Although these insights may prove valuable for the creation of conditions that facilitate the innovative process, in our view they lack specification in order to be of great value for this study. First it has not yet been researched whether there is a difference in the importance of different conditional factors for incremental and radical innovation. Moreover, the previously mentioned conditions have been researched principally in manufacturing settings. As it has become clear that the innovative process in KISFs may be different from the innovative process in manufacturing organizations (in terms of strategic, structural, style and cultural conditions), it is not clear what the influences of the studied characteristics on the innovative process underlying radical innovations in KISFs, are.

2.1.5 Conclusions

What is the relevance of the literature on innovation for KISFs? Besides similarities in the innovative processes in manufacturing and high technology firms and in KISFs, there are also a number of significant differences. In terms of technology development the most striking difference is the absence of R&D departments in most KISFs. It appears that instead of relying on inputs of separate R&D departments for innovation, the innovative process is often performed by project teams that deliver services to the client. New knowledge needed for innovation is often introduced into these teams by collaboration with other partners and especially with clients (Von Hippel, 1986; Coombs, 1999). The innovative process for KISFs is different from the process in more classical manufacturing firms:

- In KISFs R&D is rooted in the primary process rather than in separate R&D departments.
- There is an inherent barrier to acceptance of new technology in KISFs as opposed to the strong technology-based innovation in manufacturing.
- In manufacturing there is a strong role for management in the process of strategy development, the introduction of new technology and the development of technological capabilities. In KISFs this role of management is mediated by the strong influence of the professionals on the acceptance of new strategies and technology.

In line with this, it is often presumed in research on innovation in KISFs that the innovative process in KISFs is continuous rather than discrete and is based on an ongoing process of re-

invention and improvement (Robinson and Stern, 1997). As a consequence more classical research on innovation in manufacturing is considered to be of little relevance to innovation in KISFs. Recent research, however, has shown that innovation in (knowledge-intensive) services is dominated by autonomous rather than client-led innovation. As such some insights from the research on innovation in manufacturing can be used, especially those that are related to the paradigm shift model of innovation and those on the phasing of innovations. However due to the differences between KISFs and manufacturing, these insights have to be accompanied by features of the social context in KISFs that mediate the innovation process:

- Cognitive factors related to the distribution of knowledge and information.
- Social factors dealing with the development of social relations and networks.
- And organizational factors concerning organizational politics (Newell et al., 2002).

In order to keep in line with the different research disciplines we will treat these subjects under the subsequent headings of knowledge creation and knowledge management strategies (2.2), organizational learning and learning in organizations (2.3) and socio-political processes (2.4). Finally we will look at organizational conditions and the role of management (2.5).

2.2 KNOWLEDGE CREATION AND KNOWLEDGE MANAGEMENT STRATEGIES

The subject of knowledge creation and knowledge management has received substantial attention in recent years, and the importance of knowledge creation and knowledge management strategies for a company's success has been widely acknowledged (e.g. Nonaka and Takeuchi, 1995; Stewart, 1997; Cook and Brown, 1999; Hansen et al, 1999; Von Krogh et al., 2000, Davenport and Prusack, 2000; Teece, 2000; Dougherty, 2000). In order to cope with increased competition and the growing and wide availability of high level knowledge, most KISFs have embarked on some form of knowledge management to tackle the issue of knowledge creation, distribution and application. Examples are the appointment of Knowledge Officers (Van Krogh et al., 1997; Davenport and Prusack, 2000), the creation of databases and the introduction of yellow pages (Stewart, 1997; Hansen et al., 1999). The question can be asked, however, whether these actions and the introduction of knowledge management strategies are as effective as they should be, and, focussing on the subject of this study, whether they contribute towards the creation of innovations, more specifically radical innovations. In order to discuss the relevance of knowledge creation and knowledge management strategies for innovation, we will start with an overview of types and levels of knowledge especially in the context of KISFs; we will discuss the more 'traditional' approaches towards knowledge management and the pitfalls these pose for radical innovation in KISFs. From this we will discuss the emergence of new strategies and the relevance of these for innovations in KISFs. This will link the subject of knowledge creation to the subject of learning in organizations.

2.2.1 Types and levels of knowledge

One of the most relevant distinctions in knowledge is Polanyi's (1966) distinction between *explicit* and *tacit* knowledge. Explicit knowledge is codified, systematic and formal knowledge that is transmittable in formal, systematic language. Tacit knowledge is context-specific and personal, it often deals with skills or abilities, expertises, norms and values and personal percep-

tions of reality. Acquisition and distribution of explicit knowledge may be a relatively simple process as the information can be codified, chunked and transmitted through existing communication means. Books, protocols, databases are existing means by which explicit information in the form of existing domain knowledge, formal theories and approved theories of practice (Van der Sanden, 1997) can be transferred. However, the acquisition and distribution of tacit knowledge is much harder. Ability, skills, norms and values and context-specific aspects cannot be transferred in codified chunks. Different strategies are needed for this. The distinction between explicit and tacit knowledge is important for KISFs. Where more routine service organisations can store the knowledge they use in routines, which are then applied to clients, KISFs do rely on complex information that is often too complex to put down in routines, and asks for a high degree of adjustment and re-invention in application. This means that there is a large skills and context-interpretation component in the work of professionals in KISFs. Tacit information at a high level of complexity is an important part of the knowledge portfolio in KISFs. Blackler (1995) related Polanyi's distinction to KISFs and refined tacit and explicit knowledge to five knowledge categories. *Encoded knowledge* is information conveyed by signs and signals; *embedded knowledge* is knowledge that resides in systemic routines; *encultured knowledge* refers to the process of achieving shared understanding; *embodied knowledge* is action oriented; *embrained knowledge* is knowledge that is dependent on conceptual skills and cognitive abilities. The primary process in KISFs will at least require knowledge at the encultured and embodied level (Dougherty, 2000). For innovation, knowledge at the embrained level is necessary, as conceptual skills and cognition form the basis for the innovative process (Newell et al., 2002).

A second distinction in types of knowledge is the distinction between individual and collective knowledge. In combination with explicit and tacit knowledge four types of knowledge (Nonaka and Takeuchi, 1995; Cook and Brown, 1999) can be discerned: individual explicit, collective explicit, individual tacit and collective tacit knowledge.

It is in the interactive process between these four types of knowledge that one of the pitfalls of more traditional knowledge management strategies reside. One of the main assumptions in knowledge creation and knowledge management seems to be that the transfer of knowledge from the individual to the collective level and/or from the tacit to the explicit level leads to knowledge creation (Cook and Brown, 1999). But the question can be asked whether the transfer of knowledge from tacit to explicit or from individual to collective levels leads to new knowledge or whether it possibly downgrades rich contextual knowledge (embodied and encultured knowledge) to 'bare routines' and facts.

2.2.2 Knowledge management strategies

In response to the increased need for knowledge creation and distribution, several techniques and methods have been developed. In general two strategies can be distinguished (Stewart, 1997; Davenport and Prusak, 2000):

- **Stock or codified strategies:** focus on the codification and storage of developed knowledge into databases in order to make this knowledge available to others. For users the database provides the possibility to acquaint themselves with the latest insights and views. These strategies are often used for the acquisition and distribution of explicit, routine knowledge. Encultured and embodied knowledge is often too rich and complex for codi-

fication, making this type of knowledge unsuitable for stock strategies. Consequently stock strategies can be used as a basic tool for the distribution of explicit knowledge, but are not useful as a distribution tool for the richer types of knowledge that are used in KISFs.

- **Flow or personalised strategies:** focus on the flow of knowledge between users. Strategies are directed at listing knowledgeable individuals in different fields, mapping fields and names, and making these inventories available throughout the firm. Knowledge workers in need of knowledge on certain subjects or fields can use these inventories to contact other knowledge workers ('yellow pages approach'). The emphasis in this strategy is placed on the flow of knowledge. Due to the higher level of personal contact, this strategy provides more room for context-specific information and the creation of shared understanding. This strategy is thus useful for the primary process in KISFs.

Although the two strategies may be helpful in the acquisition and distribution of knowledge in KISFs, there are a number of dangers when these strategies are considered as *the* instrument for the creation of innovations (Dougherty, 2000; Teece, 2000):

- A focus on the *use of already existing knowledge* rather than on the generation of new knowledge (Dougherty, 2000).
- A tendency towards *downgrading of knowledge* (Von Krogh et al., 2000; Dougherty, 2000), as in the translation of knowledge beyond the contextual situation and/or in the transfer of knowledge from the individual to the collective level, the rich nuances of newly generated practices can often be lost. This danger will be stronger in stock than in flow strategies (see for example Brown and Duguid, (1991) concerning their treatment of canonical and non-canonical views of occupations).
- A tendency towards *self-sealing processes* (Argyris and Schön, 1974) as firms and professionals may be tempted into using 'minor modified' batches of available knowledge in situations in which newly generated knowledge is required. In particular, when efficiency in the use of knowledge and creation capacity is over-emphasised, KISFs may start losing their capacity for the critical assessment of clients' demands and subsequent needs for (incremental) innovations in the services offered.
- A *loss in potential for strategic development* as knowledge is restricted to existing frames of reference. The two strategies are based on knowledge in the primary process that is retained by the individual (groups of) professionals. There is little knowledge extraction in terms of more strategic changes and developments in the market place (Van Poucke and Van Wijk, 1995; Moore and Birkinshaw, 1998, Dougherty, 2000). This will prevent the use of knowledge for the creation of new strategic frames of reference.
- The *creation of a gap between the actual service portfolio and technology developments* since knowledge creation is based on an internal primary process rather than being linked to external technological developments.
- The danger of *alienation* due to the fact that knowledge cannot be properly applied if '*it lacks an identity of participation*' (Wenger, 1998, pp. 56). Members of groups applying new knowledge will have to assimilate this knowledge on a personal or on a group level in order to start using this knowledge in their own situation (Wenger, 1998).

In answer to these possible pitfalls there is a growing recognition that, at least for those sectors that rely on complex, non-routine knowledge, stock and flow strategies are no longer sufficient. It is in the combination of internal and external sources of knowledge that radical service innovations appear (Leiponen, 2001). Stock and flow strategies have to be complemented by strategies that are based on '*epistemology of practice*' rather than on '*epistemology of possession*' (Cook and Brown, 1999, pp. 382-383).

2.2.3 New strategies: from epistemologies of possession to epistemologies of practice

In their work on knowledge creation, Cook and Brown (1999) make a distinction between the epistemology of possession and the epistemology of practice. In their view knowledge is a phenomenon that is possessed and thus cannot lead to its own creation. The creation of knowledge is realized in practice, "*by the coordinated activities of individuals and groups in doing their real work as it is informed by a particular organization or group context*" (Cook and Brown, 1999, pp. 386-387). This process is referred to as 'knowing'. In this view the creation of knowledge cannot be based on the mere exchange of existing knowledge, which is the case in more classical approaches of the 'stock and flow strategies'. It is in the process of collective action and subsequent conversations that new knowledge is being created. The combination of knowing based on knowledge may lead to the process of productive inquiry that is focused at the search for information as a solution to existing problems. In this process of knowing the exchange between tacit and explicit and individual and collective knowledge starts. This process constitutes a 'generative dance' within which the creation of new knowledge and new ways of using knowledge is possible.

Although the expansion of knowledge creation with an epistemology of practice is essential, it may not be enough for innovations to occur. As is strongly argued in the literature on social construction (Brown and Duguid, 1991; Weick, 1995), the sharing and enactment of a collective practice is essential for obtaining new insights and thus innovation. However it can be questioned whether these processes have the potential to lead to more radical innovations rather than to improvements and incremental innovations. In Blacklers terms, encultured and embodied knowledge will be created, but it can be doubted whether embrained knowledge in the form of the introduction and creation of new concepts and cognitions, will be realized (see also paragraph 2.3).

One step up from the epistemology of practice in terms of creation of new knowledge is the information processing approach to learning and knowledge management. This approach may provide an important addition in terms of the creation of embrained knowledge, as it includes not only aspects of the epistemology of practice but also includes the possibility to import new knowledge in the process of knowing. In Huber's (1991) model of information processing four processes are identified:

- Knowledge acquisition as the process by which knowledge is obtained.
- Information distribution as the process by which information from different sources is shared and thereby leads to new information or understanding.
- Information interpretation as the process by which distributed information is given one or more commonly understood interpretations.
- Organizational memory as the process by which knowledge is stored for future use.

Whereas the steps of information distribution and interpretation can be compared to the epistemology of practice, and the step of storage in the organizational memory can be compared to the epistemology of possession, the step of knowledge acquisition can be described as a hybrid between the epistemologies of practice and possession and knowing, where knowing is based on an interaction between practice within the professional group and practice in the network outside the community of practice.

2.2.4 Conclusions

The use of more classical approaches of knowledge management strategies will not lead to knowledge creation and innovation, as they are too focused on the use and re-use of existing knowledge and on efficiency in this process. For knowledge creation and innovation there is a need for complementary knowledge strategies focussed on collective action and interaction, in which new knowledge is created in this active and interactive process.

Coupling knowing processes that are based in the epistemology of practice to processes that explicitly include the acquisition of new knowledge may not only lead to the creation of embodied and encultured knowledge but also to the creation of embrained knowledge. The combination of these types of knowledge development may account for the creation of radical innovation in KISFs. In this context we want to formulate the following proposition for our research project:

→ *The creation of radical innovations is based on knowledge that resides in the primary process of the firm and on knowledge that resides within the wider professional community outside the firm*

Important in this process is the existence of relevant networks (which may provide new technologies) and the interaction between the existing community of practice (read KISF) and those networks (Tsai, 2001).

The linked strategies of knowing and information processing may extend the primary process based strategies of knowledge management toward innovation-based strategies of knowledge management. Since these strategies are aimed at the creation and growth of knowledge we will call them *growth strategies* and add them to the already existing *stock* and *flow* strategies (Van Poucke, 2001).

In designing growth strategies we encounter again the question of the design of the underlying processes. We do not as yet know what takes place with regard to the underlying process in knowledge creation (Gieskes, 2001). In our view the description of the processes in the growth strategy has to be based on insights from (organizational) learning.

2.3 ORGANIZATIONAL LEARNING AND LEARNING IN ORGANIZATIONS

The subject of learning organizations and learning in organizations has in the last decades received even more attention than the subject of knowledge management. The growth in literature on this subject is exponential. The work on learning, however, seems to suffer from a number of shortcomings; as a result it is difficult to use it as a cumulative body of knowledge that offers

comprehensive insights. This means that we have to be cautious in using work on learning in organizations for the purposes of our study. On the basis of the pitfalls in the work on learning in organizations, and the work itself, we are selective in its use for our study. We start with a short discussion of the problems in the work on learning in organizations; then discuss the different levels of learning in organizations; and afterwards relate these levels to innovation. From that starting point we discuss some relevant streams in the work on learning in organizations. We end this paragraph with a number of propositions for our research project.

2.3.1 The work on learning in organizations: some pitfalls

One pitfall of the work on learning in organizations is the general lack of cumulative work and the lack of a synthesis of work between different research groups (Huber, 1991; Dodgson, 1993). Due to this it has been hard to develop a more complete and growing understanding of the process of organizational learning. This problem has been augmented by the fact that much of the work on learning in organizations is based on theorizing rather than on empirical work (Gieskes, 2001). When empirical work is being done, it is often isolated in character and does not build on previous work nor is it interpreted in the context of previous work. As a consequence new terminology has been developed to replace existing terminology instead of undertaking the evaluation of existing terminology and insights. As a consequence the existing body of knowledge on learning in organizations is in some aspects diffuse and is based on various theories and viewpoints that are not always generally subscribed. Although this is a shortcoming of the work, it is also a reflection of the richness of the subject it treats. Still we must be cautious in clearly defining what type of learning we are looking in to and what approach(es) we are referring to.

A more serious pitfall for the development of a cumulative and more encompassing body of knowledge on learning in organizations is the lack of a relation between the work on learning in organizations and the work on learning in general. This may be a result of the fact that work on learning in general (learning psychology/Human Resource Development) is often based on learning in educational situations rather than on learning in the workplace. It seems that there is a general fear that learning in educational settings has little relevance for learning in organizational settings. If this were the case, it would mean there is little validity in applying insights from learning processes in general to learning processes in organizations. The question is whether the insights obtained from research on learning in educational settings do indeed have little relevance for learning in organizations. The fact that there is indeed a relevance may appear from recent publications that start to use some insights from learning processes in general to learning in organizations (e.g. Easterby-Smith et al., 1999; Kessels and Poell, 2001; Rondeel and Wagenaar, 2002). It seems that the work on learning in organizations has become more substantial due to the integration of insights from learning psychology. It has to be noted, however, that one has to be careful about integrating insights from learning psychology into the work on learning in organizations. Their validity could well be strongly influenced by the types and levels of learning one is studying. This argument will be more fully developed later.

A last pitfall that is relevant to our study is the problem of definitions used and the clarification of processes and levels of analysis that are being studied. One problem is the inconsistent use of the terms of learning organizations, organizational learning and learning in organizations (e.g., Elkjaer, 1999). In general the work on learning organizations concerns the creation of organiza-

tions where learning is maximized (Senge, 1990), whereas the work on organizational learning focuses on the understanding of learning processes in organizational settings (Easterby-Smith, 1997). In our view learning in organizations has quite some overlap with organizational learning but also encompasses the work on learning in general (including learning psychology) where it is relevant to learning processes within the organization. In order to include these insights, we use the term learning in organizations. We want to note that, although this may sound paradoxical, learning can take place both within and outside the boundaries of the organization.

In the work on organizational learning and learning in organizations, one of the central issues of discussion is the level of analysis that is being used. A central question concerns whether organizational learning refers to the learning process of the collective or whether it refers to learning at a group or individual level. Some writers state that organizational learning does not take place before the entity of the whole has learned something (Stata, 1989; Senge, 1990). Others define organizational learning as a process that can occur at all levels of the organization, individual, group, corporate (Dodgson, 1993), while others argue that the process of organizational learning can only reside within the individual, as this is the only entity in whom learning takes place (Argyris and Schön, 1996). A way of dealing with this matter is to define learning as something that concerns an entity, whether it be an individual, a group, an organization or even an industry or society in general (Huber, 1991). This approach would leave room for a broad approach to the subject of learning in organizations, and would encompass the view that learning does not only take place at an individual or collective level, but can also take place at different levels (even at the same time). As we have seen in the paragraph on knowledge management, it could well be that learning takes place in the interaction between individual and collective, or in the interaction between collectives (Nonaka and Takeuchi, 1995; Cook and Brown, 1999; Tsai, 2001).

For the use of our study we will use the term **learning in organizations** and refer to this as **all work-related learning that takes place within and outside the boundaries of the organization and that is considered to be a process that concerns an entity, whatever that entity may be.**

A point missing in the literature on learning in organizations that is relevant for this study is the general lack of work on learning for innovation (Dodgson, 1993; Gieskes, 2001). As stated in the introduction it is often presumed that learning will automatically lead to knowledge creation and thus to innovation (Nonaka and Takeuchi, 1995) or it is presumed that innovation automatically assumes learning has taken place. Although we agree on the necessity of learning for innovation, we notice at the same time that little research has been done on the occurrence and role of learning processes in innovation. In this study we intend to analyze the role of learning in innovation. In order to do so a multidisciplinary approach is needed in order to account for the complexity of the process (Dodgson, 1993). We argue that the role of learning in innovation cannot be explained from of a single approach to learning. Indeed we may have to look at complementary contributions from different perspectives (Easterby-Smith et al. 1999) in order to account for the role of learning in innovation. In order to do this we start by defining different levels of learning in relation to innovation. On the basis of this we consider the contribution of different perspectives on learning on the creation of innovations.

2.3.2 Levels of learning

Sundbo (1997) related different levels of learning to innovation in a continuum of change as depicted in figure 2.1. On the basis of this continuum of change we can describe different sorts and levels of learning in relation to innovation.

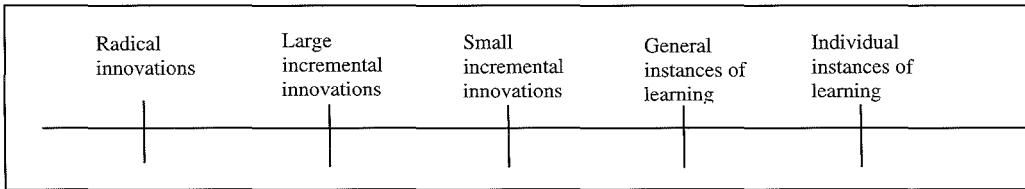


Figure 2.1 Continuum of change (Sundbo, 1997)

Level 1: reproductive learning

For a long time the general work on learning (learning psychology) was dominated by so-called reproductive forms of learning (Romiszowski, 1990), with a focus on learning routines and skills. This form of learning is based on learning explicit knowledge and simple skills by means of simple stimulus-response models. The outputs of these processes were directed toward behavioural changes. Learning in this perspective is very much a reactive process that constitutes new (simple) behaviours, but does not generate new knowledge. This level has little or no relation to learning or innovation in KISFs (Lowyck, 2001).

The knowledge-intensive character of the work in KISFs ask for complex explicit and tacit learning processes. Reproductive learning styles do not account for the type of learning that must take place in order to become a fully qualified professional (Lave and Wenger, 1991; Nonaka and Takeuchi, 1995; Wenger, 1998; Kwakman, 2001)

Level 2: productive learning

The nature of the work-process in KISFs requires productive learning (Lowyck, 2001) in relation to both the nature of the knowledge used and the primary process in KISFs.

The nature of the knowledge used in KISFs is very much of a non-canonical character. In order to understand the reality of learning in KISFs one has to abandon the view of knowledge-intensive work as formal and canonical in character (Brown and Duguid, 1991; Grundy and Metes, 1996). In essence knowledge use and the character of the work-process in KISFs is often improvisational. The reality of knowledge-intensive work can't be captured by ideal and formal functional descriptions and 'shooting scripts' for work performance. Knowledge-service work fits in with the 'situated learning view' that considers the non-canonical aspects of work as the essence of job-contents and performance process (Brown and Duguid, 1991; Weick 1995). In this view work is a process of continuous application of one's own experience and creation of knowledge and skills in new situations that need new approaches and solutions. The nature of knowledge and the primary process in KISFs asks for learning processes that are not dominantly reactive and unilateral transmissions of explicit information and knowledge, but are pragmatic acts, which take place during the interaction in work situations and which focus at the same time

on obtaining knowledge, insights and understanding and experimental application (Brown and Duguid, 1991). This mode of learning asks for a process in which learning is situated and co-constructed on the basis of collaboration and collective sense-making (Lave and Wenger, 1991; Brown and Duguid, 1991; Weick, 1995).

The second aspect that influences the process of learning in KISFs concerns the nature of the primary process that resides in the interaction between the worker and the client. As we argued, the demands of clients tend more and more towards made-to-measure services and the use of newly created knowledge. Application of routine and formalized knowledge does not meet client-expectations anymore. This means there is a need for continuous improvement and re-invention in the primary process. In the social constructivist approach learning has a central role in this process of improvement and re-invention, in essence learning is considered as the bridge between working and innovating (Brown and Duguid, 1991). The importance of learning and innovation is even stronger as a result of the high software component in the services provided by KISFs. In effect "the essence of the application of these services is the change or modification of the services in the process of adoption and implementation" (Rogers, 1995), thereby leading to fine-tuning, re-invention and subsequent incremental innovation. This process is often developed through social construction between professionals and between professionals and users in the process of service delivery (Von Hippel, 1988). As such productive learning is considered as a form of learning that is suitable to KISFs and plays a major role in the creation of incremental innovations.

Level 3: Exploitation and exploration in learning: from incremental to radical innovations

On top of productive learning, a third level can be discerned, where learning is aimed at the creation of more radical and broadly applicable innovations. This will demand for a more elaborate learning style than the style described in level two. Ulrich et al. have noted: "*with regard to the impact of innovation, learning without change occurred when individuals generate new ideas, but individual ideas are not generalized into organizational systems, or when learning is not shared across boundaries.... in this sense innovation is not only the accomplishment of an initiative but also the leverage of this accomplishment across boundaries*" (Ulrich et al., 1993, pp. 60). In their article Ulrich et al. state that there is a need for a new kind of learning capability: the ability to move the lessons learned from experience and experiments across boundaries. This ability has not as yet been described as a coherent and well-documented process nor has it been empirically researched (Gieskes, 2001), but some references to learning styles that may lead to radical innovations have been made. In terms of styles, it has been referred to as generative versus adaptive learning (Senge, 1990), as strategic versus tactical learning (Dodgson, 1991) or single-loop versus double-loop learning (Argyris and Schön, 1978). In terms of underlying processes, this level of learning has been referred to as "attempts towards synthesis by higher levels of abstraction" (Sternberg, 1997), "abstract meaningful lived experience" (Schulz, 1967) and "influences by the wider epistemic community in which professionals and knowledge workers are embedded" (Pentland, 1995).

The issue of a learning process in relation to a level of learning and a level of innovation has a strong parallel in the discussions on the difference between strategic behaviour and technological paradigms and levels of strategy and innovation. It has been argued that incremental and radical innovations demand different strategic behaviours (induced or autonomous) and different

approaches of technology strategies (incremental progress of paradigm shifts) In marking the division between learning types that relate to either incremental or radical innovation, March distinguishes exploitation from exploration in organizational learning, where “*the essence of exploitation is the refinement and extension of existing competences, technologies and paradigms. Its returns are positive, proximate and predictable. The essence of exploration is experimentation with new alternatives. Its returns are uncertain, distant and often negative* (March, 1991, p. 85). The distinction between the two learning styles seems to fit the distinction between strategic behaviour and technology strategy for different levels or types of innovations. This could mean that radical innovation demands for learning styles fundamentally different from learning styles suitable for incremental innovation.

Ulrich et al, described the process of explorative learning as high-impact learning. They related the ingredients of this type of learning to a number of processes occurring in the same order in their analysis of a number of studies into learning processes. In these studies nearly the same processes occurred, in the same order:

- Discovering and/or acquiring ideas or concepts needed for renewal or innovation.
- Selection and application of these ideas or concepts in a particular situation.
- Generalization: reflection on solutions; integration of ideas so they become more broadly available; encoding in routines, conceptual maps and norms; generalization to new situations.

In general there seems to be a central position for concept development and, as such, cognitive change in the learning style leading to radical innovation. This might mean that in the learning processes that lead to more radical innovations, cognitive learning processes rather than (or in addition to) social constructive learning processes play a role. The problem that may appear in this context is the problem of acceptance of new cognitive constructs by professionals (in line with the potential problem concerning the acceptance of new technology by professionals). In general professionals seem to prefer continuous improvement styles of learning (Argyris, 1991), and in this sense they seem to suffer more than other occupational groups from the ‘not-invented-here-syndrome’. As a consequence a more incremental and continuous social construction approach to learning is often favoured by professionals more than approaches that favour (radical) cognitive and conceptual change. A discussion of learning styles and approaches to learning in the context of innovation in the KISF may shed light on this issue.

In the next paragraph we shall treat some major approaches to learning and discuss their relevance for learning in innovation in KISFs.

2.3.3 Definitions of learning and approaches in learning

In the context of this study we will give a short overview of cognitivism, social construction and experiential learning. These approaches will be discussed with regard to innovation in KISFs. In the table on this page we start with an overview of definitions in the field of learning and relate

these definitions to a number of the categories Easterby-Smith (1997) identified in terms of approaches towards learning¹.

Human Development	Is based on cognition, learning styles, dialogue	Argyris and Schön (1978)	Organizational learning involves the detection and correction of errors, and involves repeated testing, construction and reconstruction of new knowledge
		Kolb (1984)	The process whereby knowledge is created through the transformation of experience
		Kim (1993)	Organizational learning is increasing an organizations capacity to take effective action
Sociology and Organization theory	Effects of social systems and organizational structures, rhetorics, interests of actors	Daft and Weick (1984)	Organizational learning is the process by which new knowledge about action-outcome relationships between the organization and the environment are developed
Management Science	Knowledge, memory, gathering and processing of information	Huber (1991)	An entity learns if, through its processing of information, the range of its' potential behaviours is changed
		Senge (1990)	Organizations learn only through individuals who learn
Strategic perspective	Organizational-environmental interaction; competition; levels of learning	Related to the contents of paragraph 2.1; places other learning styles in the context of gaining competitive advantage	

Having focused on the strategic perspective and the management-science perspective in the preceding paragraphs, we shall focus in this paragraph on the most important contributions within human development (cognitivism and experiential learning) and sociology (social construction).

Cognitivism

In general, cognitivist approaches to learning focus on the mental maps that reside in the minds of individuals (or other entities). The goal behind the cognitive learning process is to create change and development in these mental maps and schemes (Lowyck, 2001). Argyris and Schön (1974) refer to organizational learning as the detection and correction of errors, which involve repeated testing, construction and reconstruction of new knowledge. In this process they discern two learning models. Model 1 learning is based on single-loop learning, in which the individual evaluates the results of his own behaviour in terms of fixed results and established norms that are deduced from his theory-in-use for his work. Learning takes place within existing frames of reference and theories-in-use. Model 2 learning consists of double-loop learning, in which the existing frame of reference and the theory-in-use are changed during the learning process. In this model innovations can occur, as used routines are replaced by new mental schemes. Essential for the occurrence of double-loop learning is deutero-learning, learning-to-learn or meta-cognition (Van der Sanden 1997; Sternberg, 1998). In addition to meta-cognition, Argyris and Schön also considered the concept of 'inquiry' (Dewey 1938) as essential to their model. In inquiry the in-

¹ Easterby-Smith also identified Categories Production Management and Cultural Anthropology. We shall not discuss these since Production Management is related to learning in manufacturing and efficiency organizations and Cultural Anthropology relates to the international aspects of learning.

teraction between thought and action is created, where doubt is not only solved by referring to earlier adaptations (model 1 learning), but where doubt and new problems are actually created by the process of inquiry, thus creating the possibility for the creation of new frames of reference. It is within the use of the concept of inquiry that the process of cognitive learning is related to social processes rather than solely to individual processes. The social processes going on are central to the process of inquiry, but also condition the process of inquiry.

A second representative of cognitivism is Kim (1993) who developed a model that shows a strong resemblance to Argyris' and Schön's model of learning. Kim refers to organizational learning as the process by which an organization increases its capacity to take effective action. In his model Kim distinguishes between operational learning and conceptual learning. In operational learning, learning takes place at the procedural level, where the individual learns the steps needed for the completion of tasks. The knowledge for this resides in routines. Conceptual learning is concerned with the process of cognitive search for underlying causes for necessary variations in routines. In doing this the conditions, procedures and concepts for these routines are tested and renewed. As such, new mental models are developed. Kim's model shows many parallels with the models of Argyris and Schön.

Both Argyris and Schön and Kim extend their view on learning from the individual to the collective level. In interactive processes developed knowledge is either embedded in the organizational memory (Argyris and Schön, 1996) or is developed into shared mental models (Kim, 1993). As such, there is certainly an interactive element in their work.

In terms of knowledge creation, it seems that model 1 learning is oriented towards building encoded and embedded learning, whereas model 2 learning is oriented towards building embrained knowledge. Considering the importance of embrained knowledge and the creation of new frames of reference (new paradigms and technologies), it can be stated that model 2 learning and the switch from model 1 to model 2 learning play an important role in the creation of radical innovations. This leads to the following proposition:

→ *The creation of radical innovation is based on cognitive and meta-cognitive activities that lead to reflection and abstract conceptualization of action and experience by professionals in the firm.*

The question is, however, whether model 2 learning is a sufficient condition for the creation of radical innovation in KISFs. The process of the integration of newly developed mental models into an actual body of knowledge for knowledge workers gets little or no attention in the cognitivist approach. Lack of integration may lead to the creation of new mental models that are not used in the daily work process of professionals. In essence the socio-political element that we presumed to be essential for the acceptance of radical innovations is neglected. The occurrence of model 2 learning has to be supplemented by other processes.

Social Construction

In the last decade a social constructivist approach to learning was developed. One school in this approach is oriented towards viewing learning processes as construction processes that are aimed towards knowledge building and knowledge organisation on the basis of active information acquisition and interpretation (Van der Sanden, 2001). Cognitive processes play an essential

role in this approach. It is used mostly in educational settings. Another approach, which is oriented more towards occupational settings, is more sociological. Here learning is considered to be a product of sense-making, interaction and collaboration among members of an occupational group as they work together (Daft and Weick; 1984, Brown and Duguid, 1991). Originally this approach was directed toward learning necessary for becoming a fully fledged member of an occupational group. But over time the emphasis in this approach changed from learning as a form of *legitimated peripheral participation* (Lave and Wenger, 1991) towards learning in working that leads to improvement and innovation. The goal of learning became the creation of *collective sense-making* (Weick, 1995) and the creation of novel approaches and solutions that result from a continuous and interactive process between members of the occupational group. In this approach social constructivism is often considered the opposite of cognitivism, since the attention is on learning as an inherent part of working together in social settings (learning-in-working) rather than on learning as a reified activity that is directed toward the creation of abstract processes (Elkjaer, 1999). The attention is drawn “away from abstract knowledge and cranial processes and has situated learning in the practices and communities in which knowledge takes on significance” (Brown and Duguid, 1991).

In this view of social constructivism, learning is seen as the bridge between working and innovation. In his daily work the worker will be confronted with new problems. The situation leads to collective sense-making or enacting: the community of professionals gather information by trying new behaviours and seeing what happens (Daft and Weick, 1984). The construction of new insights and approaches are developed by storytelling (shared diagnosis by communal interpretations), extensive narration, collaboration and social construction (Orr, 1990). On the basis of this collective sense-making and trying out of new approaches, innovations are developed. The importance of the social construction of technology for re-invention and incremental innovation has been acknowledged (Rogers, 1995), and it appears that both incremental and radical innovations are influenced by organizational dynamics on the basis of interactions within occupational communities (Tushman and Rosenkopf, 1992).

Although social construction is considered to be a suitable approach toward learning and incremental innovation in occupational settings, one of its potential shortcomings, in relation to innovation, lies in its strong emphasis on group learning by communities of practice. This may lead to two restrictions on learning: the first lies in the effects the group may have on the learning process. Although the knowledge base is broadened by the group, there is also the danger of processes like group-think, strong group norms and pressure towards conformity to group norms and rules (Barker, 1993; Teisman, 1997; Newell et al., 2002). Especially in professional organisations with strong professional norms and hierarchies, social construction may be limited by pressure towards adherence to norms of the dominant coalition (Van Poucke and Van Wijk, 1995). The second restriction may lie in the limitation of group members or in the limitation of participating communities of practice. This may in turn lead to a reduced input of new knowledge, especially of knowledge that lies outside dominant frames of reference. This can create learning situations that are restricted to the ‘bounded rationality’ of the community at hand, and thus to existing conceptual frames of reference (Tushman and Rosenkopf, 1992; Wenger, 1998). In this aspect social constructivism poses a limitation for learning processes in KISFs. The approach is suitable for daily learning, improvement and incremental innovation processes, but it can obstruct the creation of more radical innovations.

In relation to this limitation, we want to mention the introduction of the concepts of inquiry (Dewey, 1934) and dialogue, (Schein, 1993; Kessels, 1994) within the social constructivist approach as a way to enrich the interactive process. When the interactive process in the group is constructed by suspension [inquiry], dialogue and metalingue, the group can surpass the abilities and creativity of the individual members. This means, however, that a certain amount of metacognitive ability as well as an ability to manage the inherent pitfalls of group processes and socio-political processes has to exist within the group. In addition to this, the process of social construction has to be accompanied by a process of sharing knowledge in groups across social communities in order to provide a starting point for radical innovation (Nahapiet and Ghosal, 1998).

Although we doubt whether social construction in itself is enough for radical innovation, we feel that the contributions of this approach towards radical innovation should be researched. We want to do this by formulating a rival proposition:

→ *Radical innovations are formed on the basis of learning processes of social construction in the organization.*

Experiential learning

The experiential learning approach refers to learning as “*the process whereby knowledge is created through the transformation of experience*” (Kolb, 1984, pp. 38). In this approach the focus is on learning as a process rather than on the outcome of learning. This does not mean that learning is not directed towards outcome, but outcomes are considered to be intermediary stages, which form the basis for further experiential learning. Knowledge and ideas are not fixed but are formed and reformed during learning. In this sense the learning process remains continuous:

Steps in the experiential learning process are depicted in figure 2-1. Characteristic elements of the experiential learning approach are:

- Learning is best conceived as a process and not as an outcome
- Learning is a continuous process grounded in experience
- The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to work
- Learning is an holistic process of adaptation to the world
- Learning involves transactions between the person and the environment.

As a consequence of these characteristics, there are two primary dimensions to the learning process. The first dimension unfolds along the line of concrete experience and abstract conceptualization, and the second along the line of reflective observation and active experimentation. The ability to integrate these four elements constitutes the ability for growth and creativity in a continuous developmental process (Kolb, 1984).

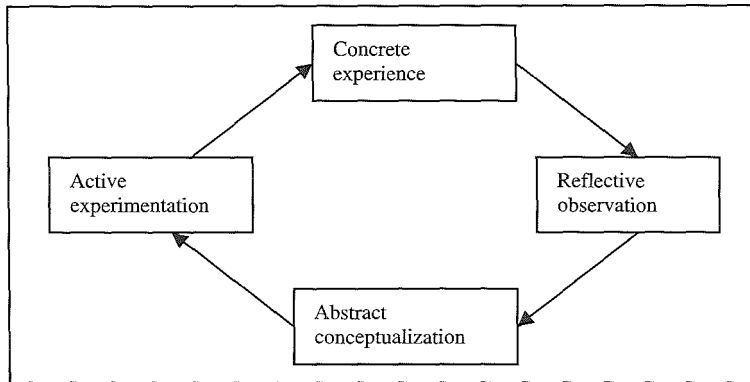


Figure 2-1: The experiential learning cycle

With regard to the characteristics we mentioned earlier we can find some leads for innovative processes in KISFs, such as: the importance of concrete experience; the resolution of dialectically opposed modes of adaptation to work; and the interaction between person and environment. Whereas in the sociological approach to social construction there was an emphasis on collective sense-making, in experiential learning there is an emphasis on dialectics and experimentation based on experience and abstract conceptualization. This leaves room for the introduction of new (and dialectic) views, which are then integrated by means of a process of reflection, abstraction and experimentation into experience. As such, the experiential learning approach allows for the possibility of introducing opposing views and new frames of reference.

In general reflection on action is considered as a suitable form of learning for professionals (Schön, 1983; Kwakman, 1999). The coupling of this learning style to abstract conceptualization may lead to the development of new concepts in the learning process of individuals. Thus experiential learning is a form of productive learning, in which the learning process is not only focused on professional development of the individual but also on development of new concepts that are valuable to the organization (Onstenk, 1997; Van der Sanden, 1999). This productive learning style, based on reflection and abstraction, seems to link in to what Schulz described as abstracted meaningful lived experience (Schulz, 1967), which he considered essential for innovations at a strategic valuable level.

In general the interaction between person and environment and the interpretation of experience in abstract conceptual processes, provides in our view for the possibility of integration of experience from the primary process that resides within individual (team of) knowledge worker(s) with insights that are the product of technology developments. In the experiential model there is room for coupling and validation of experience and new concepts and technology. As such the model of experiential learning provides room for the synergetic development of embodied and em-brained knowledge, both from inside and outside the direct professional and organizational network. In this context we want to formulate the following proposition:

- *The creation of radical innovations in KISFs are based both on the experience from the primary process by professionals and on the reflective and abstract processing of these experiences.*

There may be two general problems in the usefulness of the experiential learning model for radical innovation. One is related to a lack of attention to interactive processes within the experiential learning model. The second is related to the introduction of new technology that is essential for radical innovation. In essence the experiential learning model provides no explicit room for interaction with networks outside the organization. This may hamper the introduction of new technology. When the learning process is too focussed on learning processes within the organization, there may be too much reliance on the professionals who deliver the primary process, and thus on knowledge from existing and dominant frames of reference. This may lead to the pitfall of self-sealing knowledge development. Consequently interaction in the context of the importation of new knowledge deserves special attention in the experiential approach. Furthermore, the process of importation of new technology should be accompanied by interactive processes aimed at the evaluation of the input and worth of new technologies in the light of added value for innovations in the primary process. The question is whether and where the experiential model accounts for these socio-political processes that reside within the professional community and that influence the dynamics of acceptance of technology shifts. This could mean that the experiential learning model may provide a strong but not sufficient basis for the explanation of underlying learning processes leading to radical innovations in KISFs. In our view the experiential learning model has to be combined with:

- a. the information processing model as described in paragraph 2.2.3.
- b. attention to averting the possibly negative effects of accompanying socio-political processes. We will elaborate on this in paragraph 2.4.

This leads us to the following proposition:

→ *The creation of radical innovations in KISFs are based on the reflective processing and abstract conceptualization of experiences in the daily work process coupled to the output of information processing activities in the context of the innovative process.*

Within the context of the coupling the experiential learning model to information processing and interactive processes, we want to point at some relevant research results that seem to provide evidence for the importance of both the experiential learning approach and the information processing approach in the creation of new knowledge and innovations:

- In their research of over 380 businesses Ulrich et al. (1993) found four learning styles that organizations used to generate ideas with impact:
 - a. *Continuous improvement* (improve it): a constant determination to improve on what has been done and should be done.
 - b. *Competence acquisition* (buy it): seeking new ways of working and making learning a part of business strategy.
 - c. *Experimentation* (try it): trying new ideas and experimenting.
 - d. *Boundary spanning* (adapt it): generate ideas by going outside their boundaries and learning what other companies do.

In rapidly changing environments experimenter organizations appear to be the leading competitors. When technology shifts have just occurred, it appears that boundary spanning based on benchmarking of best practices is the best strategy for realizing competi-

tiveness (Ulrich et al., 1993). This may point to the fact that indeed experimentation (as described in the experiential approach) and boundary spanning (as described in the information processing approach) are fertile learning styles for radical innovation.

- From work on learning strategies (Van der Krogt, 1991) for professionals and goal orientation in adults (Ngy and Bereiter, 1992), it appears that there are three types of goal orientations:
 - a. *Task related strategies*: aimed at performing the tasks that are expected.
 - b. *Problem oriented strategies*: aimed at the solution of problems.
 - c. *Professional or personal knowledge-building strategies*: aimed at further professionalization and development in one's own profession.

It appears that persons who had a personal knowledge-building strategy realized the best learning results, and moreover, were able to generate new questions and problems and try to find solutions and answers to this, enlarging and reorganizing their own frame of reference in doing so. In the process of personal knowledge building and knowledge creation, reflection and abstract conceptualization seem to play an important role (Van de Sanden, 1997, 2001).

From the research it can be concluded that in the context of experiential learning and information processing, essential learning strategies for radical innovation are experimentation, boundary spanning, and problem oriented and personal knowledge-building strategies. We will link this to insights from learning psychology in paragraph 2.3.4.

A last approach that is interesting in terms of the relation of the experiential learning model to knowledge creation and innovation is Dixon's model. Dixon (1994), in her work on experiential learning, introduced an explicit (cognitive oriented) social constructivist element into the experiential learning approach. In doing so she coupled more cognitive social constructivism to the experiential learning style. On the basis of work by Bateson (1973) she developed the concept of *accessible meaning structures*. Within primary process, work related meaning structures are constructed and reconstructed in interaction with the working environment. Accessible meaning structures are the cognitive maps that are developed in this process and that can be shared with others in the organization (this sharing includes not only explicit knowledge and tacit knowledge, but also underlying assumptions and deduced inferences). Dixon couples the creation of accessible meaning structures to steps in the experiential learning cycle by a transformation of this last model to the following steps [in between brackets we couple these steps to prevailing insights in the more classical work on innovation theory]:

- Generation of information about internal and external performance [the inclusion of external performance leaves room for importation of sectoral technology developments].
- Integration of this information into the organizational context [managing socio-political dynamics].
- Collective interpretation of this information [creation of concepts and the management of socio-political dynamics and discussions within the professional community].
- Creating authority to take appropriate action based on interpreted meanings [validation and evaluation of new concepts and insights in the context of experience in the primary process and creation of a dominant design/inclusion in the organizational memory]

(Tushman and Rosenkopf, 1992; Dixon, 1994; Van der Sanden, 1999; Easterby-Smith and Araujo, 2001).

In our view, by defining these steps, she coupled not only cognitive social constructivism to experiential learning, but she also introduced components from information processing. In our view Dixon's approach goes a long way in describing the possible underlying processes for innovation in KISFs. In general Dixon's model is considered promising for learning and innovative processes in KISFs (Van der Sanden, 1999; Easterby-Smith and Araujo, 2001; Finger and Bürgin Brand, 2001). We want to make, however, some evaluative remarks. The model has as yet not been linked to organizational and managerial settings that facilitate innovative processes. This can be viewed not as a serious pitfall, but rather as a temporary shortcoming. A more structural problem in our view is the fact that Dixon has developed the experiential model into a model that is strongly based on information processing and thus on the sharing and creation of explicit knowledge. The question can be asked whether the model provides an adequate approach toward the actual acceptance and implementation of collective interpreted information (note: Dixon talks about information in this context and not about knowledge, where information is generally considered as essentially explicit in character). The fact that Dixon leaves out the stage of collective experimentation may account for this shortcoming. Another pitfall may arise because Dixon does not include the step of abstract conceptualization as an explicit step in her model. This is in our view a downgrade from the original experiential learning model. It may lead to a lack of abstract conceptualization and syntheses of imported and available knowledge, and thus a failure to create original insights.

On the basis of our discussion about the importance of knowledge management and learning processes so far, we want to draw some initial conclusions for our model for the creation of radical innovations:

- The process model for radical innovation includes a combination of:
 - cognitive processes
 - the experiential learning model
 - information processing activities
 - interactive processes that are (also) determined by socio-political processes.
- The process of radical innovation combines actual experiences from the primary process, abstract processes, and experimentation.
- Radical innovation also depends on the introduction of insights from outside the direct professional community (knowledge acquisition).

2.3.4 Coupling learning approaches to individual learning

One of the major problems concerning the existing work on learning in organizations, knowledge creation and innovation is a failure to take into account the importance of the individual human agency as well as the complexity and difficulty in learning (Dodgson, 1993). This problem can be approached by introducing models and insights from classical work on learning psychology.

A model that describes the individual learning process as the ability to learn and to learn to learn is called the subjective learning theory (Van der Sanden, 1997). This theory designates a number of aspects that determine the output of the learning process. The subjective learning theory states that learning abilities and resulting learning activities and learning outcome are influenced by:

- a. the theories of practice in a certain domain
- b. the epistemological opinion about that particular domain
- c. the learning strategy used in the domain
- d. the goal orientation
- e. the learning situation and layout.

The subjective learning theory provides a framework in which elements from the learning approaches and models we described can be fitted. By using this framework more general statements and insights from these learning approaches and models can be translated to actual learning processes and activities taking place at the level of the individual, professional group or organisation. On the basis of the discussion in the preceding paragraphs and on the subjective learning theory, we want to evaluate the contribution of the different learning approaches and models for learning processes taking place in radical innovation in the following way:

- a. **Theories of practice:** Radical innovations are based on the cognitive processes that take place in model 2 learning; this means that there is an essential role for reflective and abstract processes leading to the development of new concepts and conceptual lines. These concepts and conceptual lines lead to new theories of practice that fall outside existing frames of reference (or are based on insights from new frames of reference). For this to take place meta-cognitive processes leading to reflection and abstraction are essential. Both cognitivist approaches and the experiential learning model leave space for these processes (or place strong emphasis on these processes).
- b. **Epistemological opinion:** Radical innovations are (partly) based on new autonomous strategies and/or new technological paradigms, but from the viewpoint of socio-political processes in KISFs, these new strategies and paradigms have to be linked to existing insights and approaches used by professionals in their work process. The social constructivist approach seems to describe innovation as an incremental process that is based on insights originating from within an existing community or practice. The existing epistemological opinion in this approach points to a dominance of knowledge that resides within the existing frame-of-reference. In the cognitive approach there is a dominant role for processes leading to the creation of new frames of reference. The creation of new frames of reference can be strongly facilitated by the importation of new knowledge and insights from outside. It is not clear however how the link to knowledge used in the primary process is made (and thus how political processes are taken care of). In the experiential learning model there is, especially when this approach is combined with the information processing approach, room for the introduction of knowledge from other settings or knowledge springing from new technological paradigms. This knowledge is in the reflective, abstract conceptual and experimental phases coupled to knowledge from the primary work process and knowledge residing within and without the community of practice. As such both new knowledge and new technological paradigms and existing theories of practice are valuable in the experiential learning model.

- c. **Learning strategy:** As appears from the statements on theories of practice and epistemological opinion, the learning strategy has to be oriented toward the introduction of new knowledge and the need to link this knowledge to the knowledge residing within the existing community of practice. Whereas the dominant learning strategy in social construction can be described as continuous improvement, the dominant strategy in experiential learning can be described as experimentation (on the basis of new concepts) and when the experiential style is combined with information processing, as boundary spanning (by acquisition of knowledge from outside the direct community of practice). In model 2 learning in the cognitive approach, the learning strategy can be described as a mixture of boundary spanning and experimentation, since this model may involve the generation of new ideas by going outside the existing frame of reference and applying concepts from these new frames of reference to new contexts. On the basis of our discussion/induction of useful strategies for radical innovation, and on the basis of empirical research, the conclusion can be drawn that experimentation is the most valuable learning strategy for the creation of radical innovation in relation to technology shifts. For the application of technology shifts boundary spanning is the most adequate strategy. On the basis of this we want to formulate the following propositions for our study:
- *The creation of radical innovations are based on learning strategies that are experimental in character.*
 - *The implementation of radical innovations are based on learning strategies that are boundary spanning in character.*
- d. **Goal strategy:** In terms of goal strategy, three different types can be discerned: task related strategies, problem oriented strategies and professional or personal knowledge buildings strategies. It is not possible to give a clear-cut categorisation of goal strategies in terms of the learning approaches and models discussed, although it seems that the approach of social constructivism has a stronger tendency towards problem oriented strategies. However, all three discussed learning approaches seem to be based on a combination of problem oriented and professional or personal knowledge building strategies. What is clear, however, is that research points to the fact that professional or personal knowledge building strategies lead to the best learning results and that persons using this strategy are able to generate new questions and problems and are able to enlarge and reorganize their own frame of reference by doing this. It can be concluded that there seems to be a positive relation between a professional or personal knowledge building strategy and the reorganisation of frame of reference that helps the creation of innovations. This leads us to the following proposition:
- *The creation of radical innovations are based on goal orientations directed towards problem solving and personal knowledge building*

The last aspect that is described in the subjective learning theory involves learning situations and layout. We will turn to this aspect in paragraph 2.5.

To conclude, the subjective learning theory as a model can be used as an 'organizing theory' for the formulation of propositions describing the processes leading to radical innovations.

2.3.5 Conclusions on learning in innovation

In our view the role of learning process in innovation in KISFs is fundamental. It accounts for the processes of the acquisition and creation of new knowledge and for linking this knowledge in the primary process; as such it describes the underlying processes that take place in innovation. In order for innovations to occur, learning has to take place at the productive level. Learning processes have to include both processes of conceptual development as well as interactionist elements that are necessary for regulating the socio-political processes that play a strong role in KISFs.

Although there is insufficient empirical evidence on the subject, we want to argue that incremental innovations and radical innovations, although they may be related, rely on different learning styles. These styles are usually referred to in the literature as exploitative and explorative learning styles.

Whereas social construction may prove to be an approach to learning that has an important role in the creation of innovations, its tendency toward bounded rationality may fall short of the creation of radical innovations. On the other hand cognitive learning approaches at the second level (model 2 learning) may account for the needed amount of conceptual development in radical innovations. Nevertheless they fall short of the interactive processes that take care of the socio-political processes in innovations in KISFs and the linking of new technological paradigms to the primary work process and existing knowledge base in the community of practice. The experiential learning style seems to offer a view on learning that is suitable for innovation at all levels in KISFs since it includes both experience in the primary process and in reflection and abstraction. However, in order to include the importation of new technology, which is considered essential in radical innovation, the experiential learning style has to be coupled to the information processing approach as described in paragraph 2.2 and to an approach that accounts for the socio-political processes. The information processing approach accounts for the introduction of new technology outside existing frames of reference. The socio-political approach accounts for the interactive processes among professional communities needed for the creation of innovations and the interactive processes within professional communities needed for the acceptance and implementation of radical innovations.

2.4 THE ROLE OF SOCIO-POLITICAL PROCESSES

As pointed out in the paragraph on models and phases in innovation (paragraph 2.1.3) the realization of radical innovations depends on both technological processes and socio-political processes that involve different organizations and stakeholders. Until now only sparse attention has been paid to the role of socio-political processes on the creation, acceptance and implementation of (radical) innovations. But it has been acknowledged that socio-political processes can impede innovative processes (Utterback, 1994; Reed 1995; Newell et al. 2002). The innovation process is influenced not only by judgements about the technical effects of innovation, but also by the cognition of different social groups and actors (Newell et al., 2002). In KISFs the influence of socio-political processes on innovation processes may even be enlarged, as KISFs in themselves are strongly socio-political in character (Van Poucke and Van Wijk, 1995). Thus there is a two-

fold effect of socio-political processes, namely those inherent in KISFs and those inherent in innovation processes. In the following paragraph we shall discuss both.

As we argued in our first chapter KISFs must be aimed at conscious creativity and innovation to insure their survival. This means that the structure and culture of the firm has to provide room for creative and innovative processes. In order to accomplish this, firms tend to organize organically and flexibly around teams of knowledge workers. Mintzberg (1979) suggested that adhocracy is the most appropriate organizational configuration for KISFs. In adhocracy control tends to be based on professionalism, cultural or normative control, and shared organisational values rather than on direct hierarchical control, supervision and adherence to rules and procedures. In general the influence of professional or disciplinary ethics and norms, professional rules and control is often stronger than managerial or organizational rules and control. This often leads to conflicts between competing professionals and organizational values (Raelin, 1991). When the organizational need for innovation (amount and contents) is in line with the innovation activities within the professional group, no real conflicts will occur. However, when the strategic needs of the firm for innovation differ from developments within the professional groups, or when visions on innovation within the professional group differ, conflicts may arise. These conflicts can occur both at the moment of importation of new knowledge from outside or at the moment of actual implementation of the innovation by executing professionals.

Thus there is a strong bias toward incremental innovations in KISFs, since they are created during the service delivery process. For more radical innovation, however, importation of new knowledge from outside is needed. Yet the importation of new technology from outside is not always accepted by knowledge workers, due to a perceived 'lack of identity of participation' (Wenger, 1998). Knowledge workers may find it hard to accept new knowledge in their working practice that is not 'owned' but induced from outside (not-invented-here syndrome). The importation of new knowledge is often accomplished by cross-functional individuals or teams that cross organizational and occupational boundaries. Crossing these boundaries can often cause a loosening of professional ethics and norms; consequently the people importing new knowledge may be considered as disruptive individuals by the more dominant coalitions of knowledge workers (Wenger, 1998). This can lead to tensions within the professional group or between management and the professional group (depending on who is leading in the importation of new knowledge) or even to rejection of new knowledge by the dominant coalitions. As such, socio-political processes in KISFs may inhibit the importation and acceptance of new knowledge and thereby impede radical innovation.

It is not only the importation of new knowledge, and thus the first stages of innovation, that may lead to political tensions. The implementation of innovation may lead to tensions, as it may induce changes in the comparative value of new and previously existing knowledge and skills bases. When the changes in knowledge and skills base are especially radical in character, power may shift following changes in groups who hold the dominant competencies in new knowledge and service domains. One of the most important sources of power in knowledge organizations is expert power. Reed (1996), states that '*for experts ..in order to retain their status and position the technical instrumentation of their expertise and the territory in which its jurisdiction runs have to be effectively protected from incursion by predatory competitors if they are to remain the specialized preserve of a particular expert group*' (pp. 575). As a consequence, knowledge workers often find themselves engaged in an intense political struggle to secure, close and ex-

exploit 'jurisdictional domains' of specialized knowledge and skills that are relevant and available to them. Research on new forms of expert power and control points out, that socio-political processes become more intense and unpredictable during a period of radical change: *'during periods of upheaval, perhaps caused by the introduction of radically new technologies, and the concomitant emergence of new and competing occupational groups seeking to exploit these technologies, professionals may focus more on perceived external threats and opportunities and respond to innovations in a more political mode* (Drazin 1990: p. 259). This may mean that during the implementation process the group that sparked the innovation (be it separate groups of knowledge workers or management), will start to exert its control over the dominant coalition that is still working from the expertise base grounded in the old paradigm. As a consequence the paradigm shift will lead to a change in expertise base and new uncertainties, causing the power base of the dominant coalition to start to crumble. This movement of replacement of the power bases and thus reduction of the ability of the dominant coalition to control the primary process may lead the dominant coalition to reject the new paradigm and thus inhibit the implementation of the new innovation. This effect may be strengthened due to the high software and thus intangible character of the innovation (Newell et al., 2002), making it difficult to control the actual implementation and use of the innovation.

On the basis of the above, we want to conclude that innovation may be inhibited in KISFs both in the first stages of the introduction of new knowledge and in the subsequent stages of actual implementation of the innovation. This leads us to our next proposition:

→ *The processes that lead to the creation of radical innovations are inhibited by closed socio-political processes in a KISF (both between different professional groups and within professional groups).*

Successful radical innovation will thus ask for a positive and open political process both between professional groups (importation of new knowledge) and within the professional group (acceptance and implementation of the innovation). Open political processes are characterized by:

- open borders between different groups and frequent exchange of knowledge (free knowledge flow)
- relations influenced by added value and not by existing dominant coalitions (importation of knowledge that lies outside dominant frames of reference)
- compliance with knowledge building and investigation rather than protection of dominant bodies of knowledge.

In the course of the innovation process and the steering of socio-political processes, there is a role both for internal knowledge workers performing the primary process and for external actors, since they both may be deliverers of new technology. There is also a role for management, as they may play a role in recognizing the strategic need for innovation, in steering the creation and implementation of innovation, and in creating the conditions for innovation processes to occur. We shall elaborate on the role of management and the organization in the last paragraph of this chapter.

2.5 ORGANIZATIONAL CONDITIONS AND THE ROLE OF MANAGEMENT

2.5.1 The role of management

Research on innovation in manufacturing points out a number of roles for management in innovation (see also paragraph 2.1.4). These roles focus on strategic management (e.g. business focus and corporate objectives), cultural conditions (e.g. entrepreneurial culture and receptiveness), structure and procedures (e.g. project selection and project management) and staff and style (e.g. adaptability, market orientation and source of creative ideas). They can be divided into the role of management in the first stages of innovation and the role of management in the stages of acceptance and implementation. In the first stages the roles are related to strategic recognition of the need for innovation, market orientation and sourcing for creative ideas. In later stages they are related to receptiveness, adaptability and project selection and management. These roles are relevant not only to innovation in manufacturing but also to innovation in KISFs. The question that can be asked on the basis of the specific character of KISFs, the major role for knowledge workers in KISFs, and the described political processes, however, is whether management does actually have a directive role in the creation and implementation of innovations. Due to the high complexity of knowledge and thus to the highly complex and professional character of innovation in KISFs, the professionals themselves have to play a central role in the creation of innovations. This is also reflected in the important role of learning processes (by professionals) in the innovative process. In our view, then, management will have more of a facilitative than a directive role in the creation of innovations. This facilitative role will lie in setting the stage for innovation and the facilitation of the importation of external knowledge and new technologies (the strategic recognition of the need for innovation (Volberda, 1990)), in the management of political processes and in the facilitation of implementation of innovations (strategies that facilitate knowledge leverage (Stewart, 1997; Hansen et al. 1999).

Since there is little research to draw on in regard to the role of management in innovation in KISFs, we do want to formulate a rival proposition that is opposite to the propositions, pointing to a leading role for knowledge workers in innovation, we developed:

→ *Management plays a leading role in the creation of radical innovations in KISFs.*

2.5.2 Organizational conditions

In the paragraph on the subjective learning theory we remarked that the last aspect influencing learning abilities, activities and outcome is the learning situation and layout. In treating this aspect within the context of innovation, we want to make a distinction between the situation and layout of learning activities, and the situation and layout of innovation activities. We think there is a major difference between these two activities in terms of situation and layout. In (reproductive) learning the situation and layout of learning mostly concerns formal settings that exclude the daily work-setting, however, in innovation (learning at the level of exploitation and exploration) the process takes place in a work or work-related setting. Consequently learning is 'included' in the work process. This means that a different layout of the learning setting is needed.

An important contribution to the role of the learning situation and layout, where learning takes place in the professional settings and is directed towards work-related productive learning and

innovation, is Kessels (1996, 2001) work on the 'corporate curriculum'. In the corporate curriculum learning is an inherent part of the daily work practice and demands the creation of an environment for professionals, in which learning and innovation can take place and be stimulated.

It appears that important elements in the creation of rich learning environments are the creation of possibilities for knowledge workers to acquire:

- Domain skills and competence related knowledge.
- Problem solving skills.
- Social abilities needed for interaction.
- Reflective abilities and meta-cognitions needed for the creation, of new knowledge.
- Motivational and affective abilities needed to regulate the drive for innovation.

This requires the following conditions in terms of the learning organization and layout:

- Participation in relevant knowledge networks and the acquisition of social abilities needed for interaction.
- Conditions of peace and stability needed for enlarging and intensifying one's knowledge as well as room for reflection and meta-cognition.
- Conditions of creative disbalance that lead to the motivational and affective drive for innovation.

It is easy to see that these elements link the relevant knowledge management and learning approaches we treated in this chapter. Domain skills and competence-related knowledge, problem solving skills, and reflective and meta-cognitive abilities relate to the importance of cognitive development, reflection and abstraction in innovation. The participation in knowledge networks, social abilities and motivational and affective abilities relate to the important aspect of interaction (social construction) in innovation. Stability and tranquillity may relate to conditions promoting reflective observation and abstract conceptualization, but also to periods of technological stability. Creative disbalance may relate to a period in which dominant technologies changes. Social abilities and motivational and affective abilities may concern the abilities needed to deal with the socio-political negotiation processes that take place during the process of acceptance and implementation of innovations. In relation to our view on radical innovative processes in KISFs, where we ascribe a major role to the combination of experience and abstraction and reflection, to information processing activities and to socio-political processes, we feel that some of the conditions in learning situation and layout may be more important than others. In particular those conditions that lead to the importation of new knowledge and to reflection and abstraction will be of significant importance in the creation and implementation of radical innovations. Thus we want to formulate the following propositions:

- *Radical innovations demand organizational conditions in which there is room for reflection and the development of reflective and meta-cognitive abilities*
- *Radical innovations demand organizational conditions that stimulate participation in knowledge networks within and outside the organization*

2.5.3 Conclusions

As we mentioned, the role of management in innovation in KISFs will be restricted to a principally facilitative role in the process of the strategic recognition of the need for innovation, the importation and acceptance of new technologies, and the acceptance and leverage of subsequent innovations.

A major condition in this facilitative process is the creation of organizational situations and layouts that stimulate the creation and implementation of radical innovations. In this context there is a major role for organizational conditions that are related to the participation in networks where new knowledge can be acquired and where the abilities that play a leading role in translating this new knowledge into actual innovations can be developed.

3. RESEARCH MODEL AND PROPOSITIONS

The aim of this study is to explore the processes that lead to radical innovation in knowledge-intensive service firms and to develop a validated model for the creation of radical innovations in KISFs. In order to accomplish this the study addresses the following research questions:

1. What are the processes that lead to the creation of innovations that realize strategic competitiveness for KISFs:
 - a. What are the learning processes?
 - b. What are the interactive processes?
2. What are the phases in the creation of these innovations in KISFs?
3. What are the organizational conditions that facilitate the creation of radical innovations?

Since there is little research on radical innovation and on innovation in KISFs to tap, it is not possible to conduct a study that is aimed at testing hypotheses deduced from an existing body of research. Instead, our research focus is on the induction of a model for radical innovations and complementary practical design components, which is based on 'embryonal' research into the processes underlying radical innovations in KISFs. On the basis of our literature study in chapters 1 and 2, we have been able to sketch a first model that will be our guideline in the empirical research project. This model is 'filled in' with the propositions we developed in chapter 2. These propositions function as the major operational research questions.

3.1 PROCESS OF AND PHASES IN INNOVATION: A RESEARCH MODEL

In the preceding chapters we concluded that the classical innovation approaches provide no valid model for innovation in KISFs. They describe the innovative process as a set of subsequent steps of research and development and/or the introduction of new technological paradigms followed by decision-making and then by dissemination and implementation. On the basis of the contents of chapter 2 we want to characterize innovation in KISFs as follows:

- There is an absence of R&D departments, as a separate entity which create new knowledge or technology shifts.
- There is a strong influence of socio-political processes in the creation of innovations in terms of the acceptance of new technology and the application of innovations in the primary process.
- There is a strong role for continuous improvement in KISFs due to the character of the primary process.
- The tendency towards continuous improvement leads to incremental innovations and may play a role in the creation of more radical innovations but is in itself not sufficient for the creation of radical innovations.

These characteristics, in relation to insights from knowledge management and learning in organisations have led us to the development of a research model for the creation of radical innovations in KISFs.

This model is based in the assumption that:

- a. The processes leading to radical innovation in KISFs are (fundamentally) different from the processes that lead to continuous and incremental innovations.
- b. The processes that occur in radical innovations are a combination of:
 - o Cognitive processes.
 - o The experiential learning model.
 - o Information processing activities.
 - o Interactive processes that are determined by socio-political processes among and within professional groups.
- c. Within the processes leading to the creation of radical innovations, combinations are from the actual experiences of the primary process, from abstract conceptualization and from experimentation.
- d. The creation of radical innovations also depends on the introduction of insights from outside the direct professional community.

These assumptions are summarized in the research model depicted in figure 3.1.

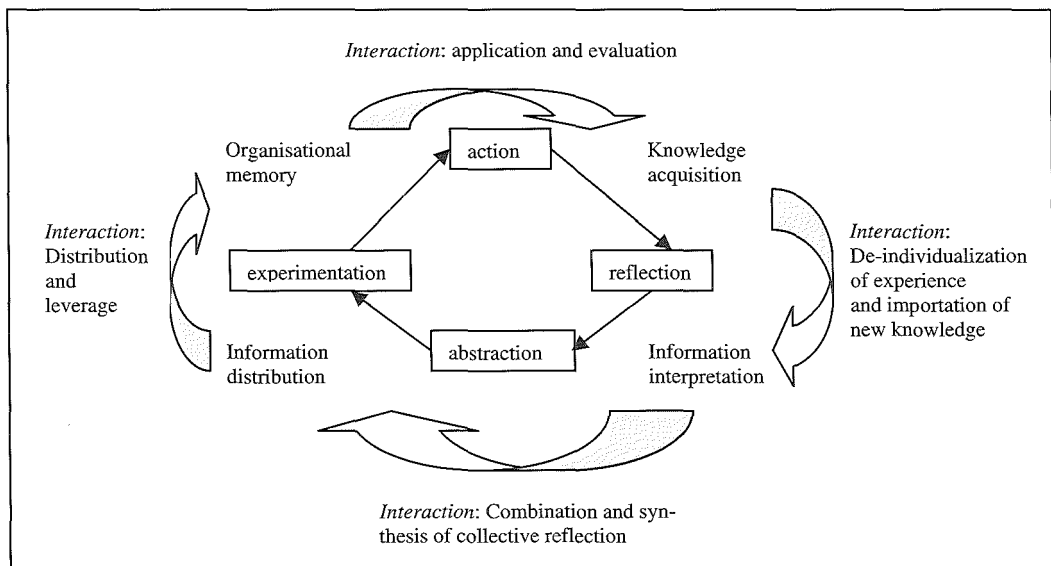


Figure 3-1: A model for radical innovation in KISFs

3.2 PROPOSITIONS

In chapter 2 we developed a number of propositions that are further elaborated in our model for radical innovation. The propositions are related to learning processes, information processing activities, socio-political processes and the role of management and organizational conditions. Due to the highly embryonic stage of our research, we also developed a number of rival propositions,

which have the function of explaining why evidence for our formulated model for radical innovation cannot be inferred because of lack of evidence (Yin, 1994).

3.2.1 Propositions related to information processing and learning

In relation to learning and information processing two more general propositions were developed:

1. *The creation of radical innovations in KISFs are based both on the experiences from the primary process by professionals and on the reflective and abstract processing of these experiences.*
2. *The creation of radical innovations in KISFs are based on the reflective processing and abstract conceptualization of experiences in the daily process coupled to the output of information processing activities that take place in the context of the innovative process.*

We have used the subjective learning theory to translate the more general statements and insights from the information processing and experiential learning approaches into actual learning processes and activities that take place at the level of the individual, professional group or organisation.

According to the subjective learning theory, learning abilities and learning activities and outcome are influenced by:

- a. the theories of practice in a certain domain
- b. the epistemological opinion about that particular domain
- c. the learning strategy used in the domain
- d. the goal orientation
- e. the learning situation and lay out.

The first two elements (a and b) of the subjective learning theory can be related to the experiential learning approach and the information processing approach as used in our model: the importance of reflection, abstract conceptualization and experimentation, and knowledge acquisition, information interpretation and distribution, which lead to the creation of radical innovations.

The second two elements (c and d) of the subjective learning theory can be related to the experiential learning approach and related research results that point to the importance of strategies of experimentation and boundary spanning for innovation, and to the importance of problem solving and knowledge building goal orientations.

In this context we formulated the following propositions:

3. *The creation of radical innovations is based on cognitive and meta-cognitive activities that lead to reflection and abstract conceptualization of action and experience by professionals in the firm*
4. *The creation of radical innovations is based on knowledge that resides in the primary process of the firm and on knowledge that resides within the wider professional community outside the firm*
5. *a. The creation of radical innovations are based on learning strategies that are experimental in character*

- b. *The implementation of radical innovations are based on learning strategies that are boundary spanning in character*
6. *The creation of radical innovations is based on goal orientations directed towards problem solving and personal knowledge building*

3.2.2 Propositions related to socio-political processes

In terms of interactive processes we found that the processes of creation and implementation of radical innovations create strong socio-political tensions in the organization and the professional community. These tensions arise when new knowledge and concepts are introduced (by management or professionals) into a professional community that is more or less closed in character. In a closed situation the professional community relies on an existing body of professional knowledge and on optimizing this knowledge. New knowledge and concepts that are imposed from outside will be rejected or accepted reluctantly. Therefore closed socio-political processes will inhibit the creation and acceptance of radical innovations. In general the socio-political processes in KISFs are strong and closed in nature. In this context we formulated the following proposition:

7. *The processes that lead to the creation of radical innovations are inhibited by the closed socio-political processes that exist in a KISF.*

3.2.3 Propositions related to the role of management and organizational conditions

Organizational conditions should be tuned towards the emergence of those information exchange processes and learning processes that lead to the creation of innovations. In line with the postulated importance of reflection and abstract conceptualization and the importance of mobilizing (external) knowledge, we formulated the following postulations on the organizational conditions for radical innovations:

8. *Radical innovations demand organizational conditions where there is room for reflection and for the development of reflective and meta-cognitive abilities*
9. *Radical innovations demand organizational conditions that stimulate participation in knowledge networks within and outside the organization*

3.2.4 Rival propositions

As this research project aims at theoretical replication rather than at statistical generalization, rival propositions were formulated. These are aimed to explain why the formulated model for innovation cannot be inferred when there is lack of evidence.

Within the scope of our literature study we formulated rival propositions regarding the influence of social constructionist learning processes and the role of management:

10. *Radical innovations are formed on the basis of the learning process of social construction in the organization*
11. *Management plays a leading role in the creation of radical innovations in KISFs.*

4. CASE STUDIES: GENERAL DESIGN AND METHODS

This chapter elaborates upon the methodology used for the empirical research of this study. We shall describe the research design, the selection of cases, method of data collection, case study database and data analysis. We finish with a definition of the variables.

4.1 RESEARCH DESIGN

One of the aims of research can be the generation of information and knowledge that can reduce uncertainty in decision-making (De Leeuw, 1996). In this research study the aim is to reduce uncertainty in decision-making in relation to the design of innovation processes that may lead to radical innovations.

In general, the results of scientific research in organisational sciences can be categorised in two models (Van Aken, 1994a):

- Descriptive models: concerned with *what is*, are descriptive and consist of algorithmic statements.
- Design models: concerned with what *could be*, are prescriptive and consist of heuristic statements.

The distinction between descriptive models and design models parallels the distinction between research strategies aimed towards theory testing and those aimed towards theory building. Research strategies for theory building are often based on inductive reasoning and use qualitative research instruments. Research strategies for theory testing are often based on deductive reasoning and use quantitative research instruments. The preference for one of these models or strategies is often determined by both the nature of the research problem (is it well, moderately or ill-structured) and by the status of theory development (theory building, testing or expanding).

In our subject of study there are, as stated before, few explicit theoretical models. Also our subject is, due to the character of KISFs and radical innovations, often ill-structured.

Our aim is to contribute towards model building for radical innovations in KISFs. As such we choose a research strategy aimed towards theory building, based on inductive reasoning and the use of qualitative research instruments. We seek the development of a design model for radical innovation in KISFs that gives a number of heuristic statements (practical design components) that may guide the design for development of radical innovations. The model and guidelines provide a wide range of possible actions to generate radical innovations.

In order to develop the model and practical design components, we perform a research project that is divided into two parts:

- *A descriptive part aimed towards developing a conceptual framework:* On the basis of the literature study in the fields of innovation theory, knowledge management, learning in organisations and socio-political processes, an initial conceptual framework is developed and an initial theory about the subject of study is created. This framework serves to facilitate and guide a data collection process, to confine the possible level of generalization

and to avoid ending up with story telling rather than theory building or theory testing (Vreede, 1995). The initial conceptual framework offers a rough outline of the theories into which the case studies will be entered. On the basis of the initial framework, two sets of case studies are performed. In each set a successful and an unsuccessful innovation are compared and in the context of the conceptual model and the accompanying propositions, the underlying processes for each case are described. On the basis of each set of cases and additional literature study, the initial conceptual framework is developed into a more mature conceptual framework. On the basis of the total descriptive research phase the conceptual model is translated into a process design model for radical innovations in KISFs.

- *Prescriptive part: Towards a process design model:* The second phase of the research project is aimed towards testing the process design model. The test is performed in order to measure the demonstrable contribution of the knowledge developed in the design model, under the denoted circumstances, to the targeted result (does it 'work'). The test of the process design model is performed by applying the model and practical design components in a radical innovation process in a KISF and evaluating the results from the application of that model.

For our research the inductive hypothetical research strategy (Sol, 1982) proves suitable, as it supports theory building in ill-structured situations. The strategy consists of five steps (Sol, 1982; Vreede, 1995):

- Initiation: using a number of rudimentary theories to describe some empirical situations.
- Abstraction: the essential aspects are abstracted into a conceptual model.
- Theory formulation: from the descriptive model a prescriptive conceptual model is derived.
- Implementation: in order to test and validate the conceptual model, it is implemented in one or more empirical situations.
- Evaluation: the results of the empirical situation are evaluated.

The use of the inductive hypothetical research strategy in our study is illustrated in figure 4.1. Our research project is conducted according to the steps depicted:

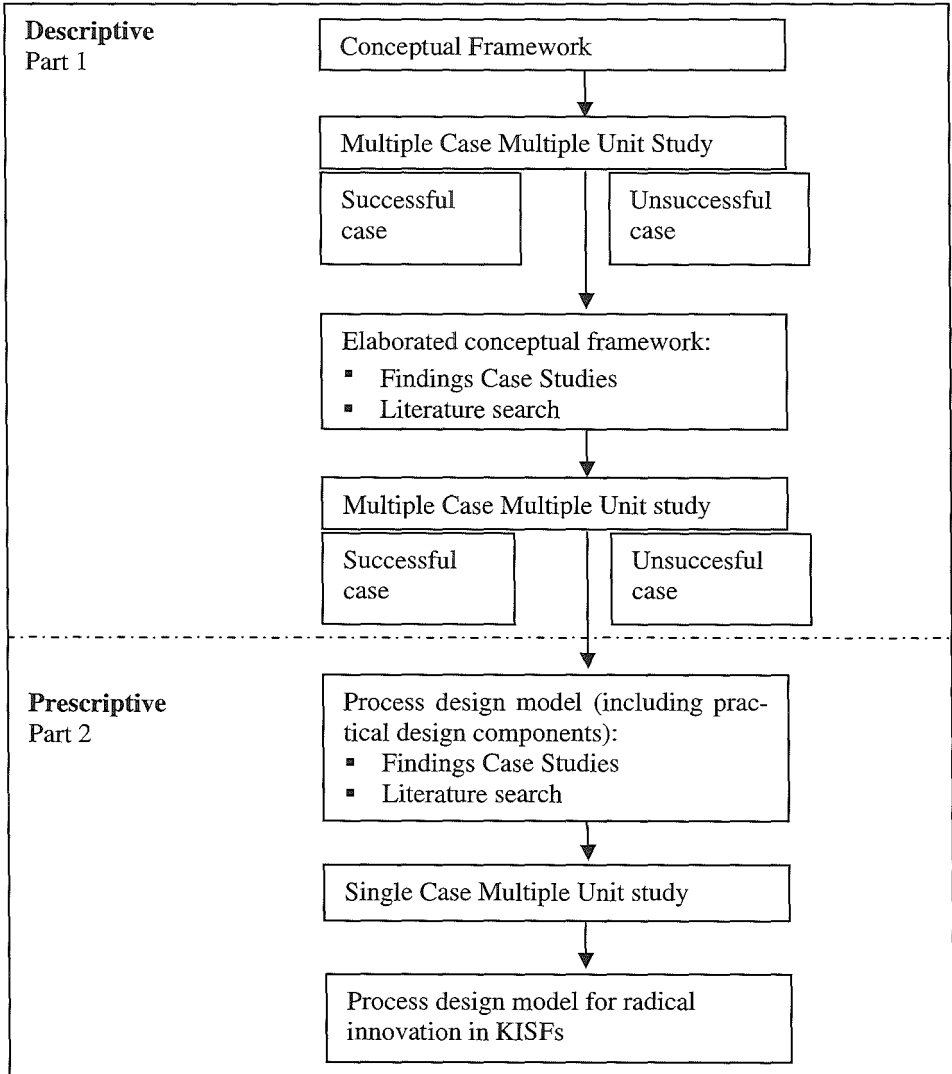


Figure 4.1: Steps in the research process

Generalizing from case study to theory

There are often critiques on the level of generalization of findings from case studies in terms of their *internal and external validity*. The *internal validity* can be enhanced by creating analytic generalization (Yin, 1994). In order to create analytic generalization we strive towards:

- Literal and theoretical explanation.
- Excluding rival explanations.
- Explanation building.

In this study literal explanation of the research results is obtained by using two series of successful case studies and subsequently by strengthening the research findings with a case study where the developed model is applied and its effects are studied. Theoretical explanation of the research results is obtained by using contrasting sets of cases, as successful and unsuccessful radical innovations are compared using the same variables. The internal validity of the research findings is strengthened further by excluding rival explanations. In the case studies not only the theoretical propositions but also a number of rival propositions are tested in order to exclude alternative explanations for the findings in the study.

A third way we use to strengthen the internal validity of the study is by building an explanation about the case studies. Yin (1984) points to the fact that a final explanation is the result of a series of iterations. Initial propositions are developed, the findings of an initial case study are compared against the propositions, the propositions are revised, and the findings of a new case study are compared against the revised propositions. This iteration is included in our case study.

In terms of the *external validity* we want to discern between algorithmic statements and heuristic statements. In the use of design models on the performance of organisations, statements can be delivered in these two forms: algorithmic and heuristic statements. There are several pitfalls in using algorithmic statements. As we are using a limited amount of case studies, the small amount of observations may prevent us from detecting algorithmic statements. The highly complex character of KISFs and of radical innovation processes, may also hamper the external validity of algorithmic statements. In the use of design models 'clinical' knowledge in the form of heuristic statements can play an important role as well. A heuristic statement can never be proved, but can only be tested by one of the four requirements of scientific knowledge (Van Aken, 1994a):

- are developed within a scientific research programme
- are transferable to other persons by means of writing
- are generalised to other situations
- are tested.

Our research is suitable for the development of heuristic statements. Confidence in the effects of heuristic statements is created by gathering supporting proofs in clinical situations (the case studies). This proof consists of justifiable observations, most of them qualitative, of the heuristic statements under diverse circumstances.

4.2 SELECTION OF THE CASES

The selection of the class of cases is based on the organisations studied in this research, i.e. the class of knowledge intensive service firms. The case study research can be divided into two parts. The first part can be characterized as two sets of multiple case studies with multiple units of analysis (chapters 5 and 7), focusing on both literal and theoretical replication. This type of study is described by Yin as a type 4 study (Yin, 1994). In order to realize both literal and theoretical replication, the research design consists of two sets of contrasting cases: successful and unsuccessful radical innovations. The cases are selected on a preliminary judging in terms of degree of radicality and success of the innovation. In the research process a reliability test on the correct use of the labels 'successful' and 'unsuccessful' is run. Each set of successful and unsuccessful cases is selected from the same organization. This set up is chosen to control for intervening independent variables (organizational influences) that are not relevant for this study. By choosing the set of cases from the same organization, it is presumed that there is a comparable 'organizational and environmental' situation that does not have interfering influences on the set of cases.

The second part (chapter 11) consists of a case study which is, as contrasted with the other two case studies, a single case study with multiple units of analysis with the function to confirm or challenge the developed process design model.

Selection of the cases is based on:

- The type of organization.
- The type of innovation.
- The degree to which the innovation was considered successful or unsuccessful.

The organizations in the first part of the study concern:

- Two educational institutions that form part of a university.
- An architectural firm.

In the second part of the study we deal with a case in again an educational institution being part of a university.

With the choice for these organizations, both profit and a not-for-profit types of KISF are selected. Consequently it can be presumed that the organizations are representative for both profit and not-for-profit KISFs. This choice is made to provide for maximal *external validity* (Yin, 1994) of the research results for the wide range of KISFs.

Important for the selection of the organization is the occurrence (or creation) in the organization of both a successful and an unsuccessful innovation within the recent past. In both sets of cases the choice is made to select innovations that dealt with the primary process of the firm and that are related to service provision to clients. In this sense the choice of the cases is considered to be representative for major innovation processes in a wide range of KISFs.

For the selection of the type of innovation (incremental or radical) criteria are used to distinguish between radical and incremental innovations. These criteria are a further elaboration from the

characteristics as defined for function and success of the innovation in paragraph 4.6 (see Appendix I). On the basis of this list radical innovations were identified and selected.

On the basis of the criteria for radical and successful innovations, two potential organizations were selected. CEOs of these firms were contacted. During the first contact with the CEO the occurrence of radical innovations in their organization was checked. We asked the CEOs to offer two contrasting radical innovations: a successful one and an unsuccessful one. At the outset of the project, we left the definition of success or failure of the innovation to the CEOs. During the research project a test was run on the success or failure of the innovation on the basis of the characteristics mentioned in paragraph 4.6.

During the research project it soon became clear how difficult it is to obtain access to information or relevant stakeholders when the unsuccessful innovations are too openly designated as unsuccessful. Therefore the unsuccessful innovations were not described as unsuccessful to the participants in the research project.

The total range of innovation cases, including the participating organizations and the subjects of the innovations, were:

- University Utrecht (multiple case multiple unit study):
 1. Faculty of Medical Education: curriculum renewal (case 1 further named as Medical Education).
 2. Faculty of Social Sciences: curriculum renewal (case 2 further named as Social Sciences).
- MVRDV Architects (multiple case multiple unit study):
 3. Development of a new concept for rural architecture (case 3 further named as Pig City).
 4. Development of a new concept for suburban living and building (case 4 further named as Lite City).
- University Utrecht (single case multiple unit study):
 5. Faculty of Pharmaceutical Sciences: curriculum renewal (case 5 further named as Pharmacy).

4.3 DATA COLLECTION

Data is collected by the investigator, according to a data collection protocol. The protocol contains guidelines for the preparation of the case study and the collection of data. The protocol covers the following sections (see Appendix II).

- A. Procedures (see appendix II):
 - Orientation and access:
 - a. Review of preliminary information
 - b. Check on suitability of the organization and cases
 - c. Check on access procedures.

- B. Determination of persons to be interviewed and other sources of information (see appendix II):
 - Guidelines for persons to be interviewed
 - Guidelines for other sources of information
- C. Questions for interviews (see appendix III):
 - Definition of innovation:
 - a. Topics
 - b. Questions
 - Learning style and information processing:
 - c. Topics
 - d. Questions
 - Socio-political processes:
 - e. Topics
 - f. Questions
 - Organizational conditions:
 - g. Topics
 - h. Questions
- D. Analysis plan and case study report (see appendix IV, V and VI):
 - Description of the innovation
 - Comments on the character of the innovation and success of the innovation
 - Description of the innovative process
 - Description of learning style and information processing
 - Description of socio-political processes
 - Description of organizational conditions
 - Comments of the investigator.

There are a number of techniques for collecting data in qualitative case studies, e.g. documentation, archival records, interviews, direct observations, participant observations and physical artefacts. The various sources are considered to be highly complementary. Therefore '*triangulation....using of multiple sources of evidence*' (Yin, 1994, p. 91) is recommended for case studies. Where different sources are used to create *converging lines of inquiry* (facts being confirmed by multiple sources of evidence), the *construct validity* of the case study especially is enhanced.

In our case study *construct validity* is realized by use of triangulation and converging lines of inquiry. Different sources of data are used in the data collection for the case study: interviews, document analysis, recorded proceedings of the process and (where relevant) physical artefacts. As the actual inquiries are retrospective, direct observation or participant observation of the innovation processes is not possible. Recorded proceedings of meetings and brainstorm sessions are used as a substitute for these observations. The data sources are handled in such a way that converging lines of inquiry for the obtained research findings were acquired.

4.4 CASE STUDY DATA BASE

The investigator started with exploratory meetings with CEOs and an examination of relevant documents to judge the suitability of the organization and the cases. The investigator interviewed top managers and managers, project managers, the initiator/the key person(s) in terms of content, and other active participants in the innovation process. The interviews lasted in general two hours. Interviews are condensed to the relevant parts of the interview. The condensed interviews were returned to the interviewees for correction and additional comments.

The investigator studied relevant documents and physical artefacts such as meeting proceedings, reports, evaluation reports, letters and memos, designs and videos.

Finally the researcher set up a case study database containing:

- General information on the case.
- Interview reports.
- Results of the document search.
- A case report.

The case reports are discussed with the top manager for correction and collection of relevant background information.

4.5 DATA ANALYSIS

Each database contains more than thirty pages of text. Data reduction is accomplished by applying coding and display techniques as described by Miles and Huberman (1994). The coding scheme is derived from the proposals, the variables and their items. The codes are used to mark segments in the interview, and to mark relevant segments in the documents. On the basis of this coding all information from the interviews and document search is clustered in terms of the variables or items. Appendix V and VI contain the coding scheme for this study.

Both within-site and cross-site data analyses are performed on the data sets by means of coding and subsequent presentation in illustrative display formats. For within-site analysis 'conceptually clustered matrices' are used. On the basis of our theoretical model and the propositions, a number of variables (concepts) are described. These variables are placed in matrices (columns). On the basis of the single case study (within-site analysis), rows of data from different sources and actors are placed in the columns regarding the different variables (for an example of a more elaborate within-site data display see appendix VII). For the cross-site data analyses 'conceptually ordered displays' are used (Miles and Huberman, 1994). The columns of concepts used in the within-site matrices are duplicated in the cross-case matrices. Per row the combined data from each case is placed. Rows are defined in terms of both the different cases and the label successful or not successful for the innovation at stake.

After initial analysis of the cases, matrices on other relevant insights are developed. These matrices are based on memos (Glaser, 1978) that are developed during the case studies and dis-

cussed with the promoters of this study. These memos are used as a base for the development of additional propositions.

In order to obtain *inter judges reliability* a secondary data analysis is performed by two external judges. For one case and one set of the variables matrices are developed, data reduced and conclusions drawn. The results of this secondary analysis are for about 80% comparable to the results of the initial analysis.

4.6 DEFINING THE VARIABLES

From the conceptual framework and its constructs the following variables are derived:

Variable: **Radical innovation** (Burgelman, 1983; Volbeda, 1990; Tushman and Rosenkopf, 1992)

A radical innovation implies the creation of a service or a product that is a fundamental shift from services or products that are provided. Radical innovations are defined in this study in terms of their success and their function.

Success: implies the degree in which the innovation yields improvement of the (future) strategic position of the firm. Success is defined by the following characteristics:

- = possibility to implement
- = duration of life
- = realization of goals
- = realized pay offs (e.g. improved market share, improved turn over)
- = considered success by relevant others.

The innovation is regarded as successful when there is a positive evaluation on at least three of the five mentioned characteristics.

Function: implies the degree in which the innovation regards a fundamental shift in underlying concepts or technology, this is defined by the occurrence of a number of the following characteristics:

- = a basis for the development of new services or products (a concept or prototype)
- = a lead to new insights in the wider professional community
- = generalisation to the wider professional community
- = improvement of the professional status of the firm (clients and/or the wider professional community).

The innovation is regarded as radical when there is a positive evaluation on at least three of the four mentioned characteristics.

Variable: **Experiences** (Argyris and Schön, 1978, Kolb, 1984; Tushman and Rosenkopf, 1992; Dixon, 1994).

The use of experiences in the innovative processes refers to the use of experiences that are rooted in the primary process and that comprise the following characteristics:

- = knowledge that is based within used frames of reference
- = knowledge that is based on existing dominant views within the profession
- = knowledge that is rooted in the actual work process of the professionals
- = knowledge that is created during in the actual work process of the professionals
- = used theories-of-practice

The use of experiences is scored on a 5-point scale between high – medium – low.

Variable: **Reflective processing and abstract conceptualization** (Argyris and Schön, 1978; Kolb, 1984; Kim, 1993).

Reflective processing and abstract conceptualization in innovative processes refers to the handling of theories (of practice) and the handling of epistemological opinions and learning strategies and goal orientations. Reflective processing and abstract conceptualization comprises the following characteristics:

- = exchange of knowledge between different frames of reference
- = interaction between theories-of-practice and more abstract views and theories
- = the use of both cognitive and meta-cognitive abilities
- = reorganisation of the actual knowledge base
- = development of synthesized views

The use of reflective processing and abstract conceptualization is scored on a 5-point scale between high-medium-low.

Variable: **Information processing activities** (Huber, 1991; Eisenhardt and Santos, 2002).

Information processing activities in innovative processes refer to the acquisition of information and knowledge, the interpretation of information and knowledge and the distribution and application of this processed information and knowledge. Information processing comprises the following elements:

- = importation of knowledge from outside the actual working process
- = interpretation and integration of knowledge from outside into the context of the working process
- = interaction between knowledge residing in the work process and new knowledge
- = integration of new knowledge and knowledge residing in the work process
- = distribution of acquired and interpreted knowledge in the organization
- = application of integrated knowledge.

The variable information processing activities based on the above definition is divided into 4 sub-variables:

Knowledge acquisition:

- = importation of knowledge from outside the actual working process

Knowledge interpretation:

- = interpretation and integration of knowledge from outside into the context of the working process

- = interaction between knowledge residing in the work process and new knowledge
- = integration of new knowledge and knowledge residing in the work process

Knowledge distribution:

- = distribution of acquired and interpreted knowledge in the organization

Knowledge application:

- = application of integrated knowledge into the primary work process.

The four variables are scored on a 5 point-scale between high-medium-low.

Variable: **Learning style** (Ulrich et al, 1993; Davenport and Prusack, 2000).

The learning style implies a cognitive style for the acquisition and/or generation and/or transformation of knowledge as part of the innovative process. The learning style can be deduced from conceptions about learning, the orientation towards learning and the preferred activities in learning. The learning style can be classified into 4 different categories:

- = Experimental learning style characterized by:
 - = generation of new ideas by going outside existing frames of reference
 - = trying out of new ideas
 - = application of new ideas
- = Boundary spanning learning style characterized by:
 - = adaptation of ideas used by others (outside the own unit)
 - = application of ideas from others outside the unit in the own context
- = Competence acquisition characterized by:
 - = acquisition of ideas developed elsewhere
 - = acquisition of competences developed elsewhere
 - = acquisition of units with special competences or ideas
- = Continuous improvement characterized by:
 - = development of ideas on the basis of practical experiences
 - = adaptation of new ideas towards practical possibilities (existing circumstances)
 - = improvement of existing services or products
 - = adaptation of existing services or products towards clients' needs

Each of the learning styles mentioned is considered to occur when there is a positive score on the majority of the characteristics.

Variable: **Goal orientation** (Van der Krogt, 1991; Ngy and Bereiter, 1992; Van de Sande, 2001)

A goal orientation is the orientation to realize certain goals as an effect of the learning activity. The goal orientation can be classified into 3 different categories:

- = Task-oriented goal orientation

- = oriented towards the completion of determined tasks
- = Problem-solving goal orientation
 - = orientated towards the solution of existing problems
- = Personal-knowledge building goal orientation
 - = oriented towards personal development
 - = oriented towards the development of knowledge in the professional field
 - = oriented towards the generation of new questions and problems

Each of the goal orientations mentioned is considered to occur when there is a positive score on the majority of the characteristics.

Variable: **Socio-political processes** (Mastenbroek, 1988; Tushman and Rosenkopf, 1992; Schein, 1993; Reed, 1996; Wenger, 1998)

Socio-political processes are those processes within the group of professionals and/or between the group of professionals and management, and/or between the group of professionals and outsiders. These processes influence the degree of openness in the mentioned groups, the exchange of information between these groups, the acceptance of (new or each other's) ideas. Socio-political processes may be influenced by the composition of the group, the criteria for admission of new members, the character of team members and the culture in the group. Socio-political processes can be characterized as either open or closed.

Closed socio-political processes	Open political processes
<p>Between groups</p> <p><i>Information exchange</i></p> <ul style="list-style-type: none"> = closed boundaries between the group and others = limited exchange of information with outsiders (non members of the group) <p><i>Foundations for relation</i></p> <ul style="list-style-type: none"> = relations influenced by existing coalitions <p><i>Characteristics of communication</i></p> <ul style="list-style-type: none"> = communication based on existing assumptions 	<p>Between groups</p> <p><i>Information exchange</i></p> <ul style="list-style-type: none"> = permeable borders between the group and others = frequent exchange of information with outsiders (non members of the group) <p><i>Foundation for relation</i></p> <ul style="list-style-type: none"> = relations influenced by added value <p><i>Characteristics of communication</i></p> <ul style="list-style-type: none"> = communication based on dialogue
<p>Within groups</p> <p><i>Relations</i></p> <ul style="list-style-type: none"> = binding based on protection of status quo or existing power balances = strong compliance to group norms and values = selection of members on the basis of retention of status quo or political relations <p><i>Goal orientation</i></p> <ul style="list-style-type: none"> = aimed towards preserving and optimizing existing bodies of knowledge and methods <p><i>Attitudes</i></p> <ul style="list-style-type: none"> = defensive = optimizing attitude 	<p>Within groups</p> <p><i>Relations</i></p> <ul style="list-style-type: none"> = binding based on development of knowledge = low compliance to group norms and values = selection of members on the basis of added value <p><i>Goal orientation</i></p> <ul style="list-style-type: none"> = aimed towards development of new knowledge and methods <p><i>Attitudes</i></p> <ul style="list-style-type: none"> = investigative = entrepreneurial attitude

The socio-political process is scored on a 5 point-scale between open-medium-closed on the basis of the occurrence of the mentioned characteristics.

The socio-political processes are described by identifying the following groups:

- = Internal circle: professionals performing the primary process
- = Strategic circle: executives or professionals holding posts that influence the strategic process
- = External circle: relevant others, external to the firm.

Variable: **Room for reflective and meta-cognitive abilities** (Volbeda, 1990; Kessels, 1996; Amabile, 2002).

Room for reflective and meta-cognitive abilities refers both to the opportunity provided by the organisations to view problems/tasks at hand from different sides and to the opportunity for dialogue and reflection in problem solving, including the degree to which leaders and project teams are open for new, divergent solutions and the ability to acquire reflective and meta-cognitive skills for problem solving. Room for reflective and meta-cognitive abilities comprise the following elements:

- = inclusion of time for reflection on goals, approach and design of the process
- = the occurrence of reflective processing of the problem and/or solutions
- = the occurrence of dialogue in the innovation process
- = acceptance of new and divergent ideas by management and/or the project team
- = the opportunity to acquire or enhance reflective and or meta-cognitive abilities.

The variable 'room for reflective and meta-cognitive abilities' is scored on a 5-point scale between high-medium-low.

Variable: **Participation in knowledge networks** (Volbeda 1990; Huber 1991; Amabile, 2002, Kessels, 1996; Stewart, 1997).

Stimulation of participation in knowledge networks in innovative processes refers to the opportunities provided by the organization and management for knowledge workers to participate in both internal and external networks that convey knowledge that is relevant to actual and future operating areas of the firm. Stimulation of participation in knowledge networks comprises the following elements:

- = participation of the organisation or members of the organisation in external knowledge networks that are relevant to the innovative process
- = existence or creation of internal knowledge networks that are relevant to the innovative process
- = stimulation of active knowledge sharing in the organisation
- = stimulation of active knowledge sharing outside the organisation
- = stimulation of mobilization of workers in the organisation in relation to knowledge sharing
- = stimulation of mobilization of workers outside the organisation in relation to knowledge sharing.

The variable 'participation in knowledge networks' is scored on a 5-point scale between high-medium-low.

5. RESULTS MEDICAL EDUCATION AND SOCIAL SCIENCES

This chapter is a reflection of the results of the first two case studies. The first part of this chapter starts with a description of each case; followed with the results in a condensed form by presenting within-site displays for each case (results of Medical Education in 5.1.2, results of Social Sciences in 5.2.2). The displays are constructed on the basis of the variables and actors in the case studies and are based on the information from interviews, relevant documents and physical artefacts.

Both case studies are performed in the same organization, i.e. Utrecht University. The first case is labelled as a successful innovation. The second case is labelled as an unsuccessful innovation. The within-site displays are transformed into cross-case displays which compare the results from both the successful and the unsuccessful innovation in the same organization (5.3). On the basis of this comparison first conclusions are drawn on factors influencing the success of the innovative process (chapter 6).

5.1 RESULTS CASE MEDICAL EDUCATION

5.1.1 Case description

The Faculty of Medicine of University Utrecht provides a six years' curriculum for the basic education of physicians. In the preceding years the medical curriculum received a negative evaluation twice in a row by an official quality assurance committee, i.e. the visitation committee. This forced the board of the faculty to embark on a fundamental renewal of the curriculum. First developments for the new curriculum started in 1997; the first year of the new curriculum was introduced in 1999-2000.

Causes for change

The causes requiring change were both external (negative evaluations) and internal (internal demand for change). The original curriculum had a strong split between theory and practice. The first two years of the curriculum were especially focussed on fundamental biomedical issues (in effect the first two years of the original curriculum consisted of collective general education for both medical and biomedical students). A number of staff members within the faculty (but not a majority) had a wish to transform the 'split' curriculum into a curriculum where theory and practice are integrated and are oriented towards the (scientific) professional training of physicians. Others, however, were strongly in favour of a more theoretical and fundamental curriculum and of maintaining the status quo.

Innovation process

To give shape to the new curriculum a 'strategic group' (CNGC) was formed. This group was commissioned to develop a basic plan (blue print) for the new curriculum. This blue print had to be based on actual insights from learning psychology and education, from the combination of professional training and a scientific curriculum, and, from views on the organization of the curriculum (which is rather complex due to the number of internships, number of students, room for internships and concept of education in small groups).

The CNCG consisted of:

- A chairman, who is a strong opponent of the old curriculum. He advocates, but his ideas are not accepted. On request of the vice-dean he becomes chairman of the strategic group. Additionally he is a member of many relevant professional networks (e.g chairman of the national committee of general practitioners). He also participates in national and international groups that meet to discuss education in the medical profession.
- Members, who are, in general, highly regarded senior staff members (professors) and who represent different disciplinary groups. Most of them are proponents of a more integrated curriculum (professional and scientific training); one is an opponent. Most members of the CNCG, later on in the process of curriculum development, act as chairmen of project teams).

In addition to the CNCG a working committee which deals with the more managerial issues of the curriculum renewal (project management) functions.

The CNCG reports directly to the vice-dean, who is also a member of the board of the university hospital. The vice-dean has strong strategic and integrative powers. He is a strong proponent of a more modern curriculum in which both professional and scientific training is more integrated. The university board amply facilitates the group but also puts a time restriction on the project and demands implementation of the first new curriculum year within eighteen months after the start of the project.

The CNCG, and its chairman especially, start the process of curriculum renewal with extensive external knowledge acquisition. Educational specialists are asked to give a view on the latest insights in learning processes and translate this into an educational set-up for the curriculum. Diverse medical and medical related professional groups and groups of students are asked to give their view on a new curriculum. Members of other universities who have just fundamentally changed their medical curriculum are invited and questioned on the changes and on what they would have done different if given another chance. It is the chairman especially who is very open to new and deviant opinions and imports these into the CNCG. He is able to do so as he is strongly supported by the vice dean. Most members of the CNCG join in into the new views, but are more reticent. One member holds on to more conservative ideas.

On the basis of this newly formed body of knowledge and the basic ideas formulated by the chairman, the CNCG starts to form a central concept for the new curriculum (contextual learning, the Z-curriculum and early internships). The members of the CNCG evaluate their own wide professional and personal experiences within the context of the new concept. On the basis of this the CNCG together design outlines for different parts of the curriculum. The central concept and the outlines of the new curriculum are laid down in a blue print. This blue print is used for extensive communication with other (senior) staff members and students of the faculty. The blue print met with mixed feelings: a number of proponents favour an emphasis on (practical) professional training, but a large number also oppose the relinquishment of the more fundamental scientific character of the new curriculum. In general the concept of contextual learning proves hard to master and is not agreed upon by a large number of senior staff members. In this phase a lot of energy is undertaken by members of the CNCG who talk with other senior staff about the contents and advantages of the new plan. In the end the CNCG decides to hold on to

the blue print and asks the board to approve of the blue print. The board decides in line with the advice of the CNCG.

The concept functions as a basis for the further development and realization of the new curriculum. It is used as a guideline by project teams actually to develop the final program, and is also used by the CNCG to test subsequent developments by the working groups. On the basis of these tests alterations are made, realising an alignment on the concept for the whole curriculum. As a result of the fact that members of the strategic committee chair the meetings of the most important working teams, engagement to the blue print of the new curriculum is strengthened (members of the strategic committee are selected on the basis of their innovative abilities and strong informal leadership within the organisation).

The project teams base themselves in the development of the new curriculum on the developed concept, on their own experiences in operational work and daily practice, and on insights from other universities. Internal knowledge networks are formed and used in order to obtain information and to share and create acceptance for the new ideas. In this phase of the innovation process a new director for the educational institute is recruited. He is an outsider who is a strong proponent of the concepts of the new curriculum, who (as an outsider) helped develop the new ideas, and who has a track record of research in the area of the chosen educational concepts. The new director plays a strong role in the actual realization, implementation and further development of the new curriculum and in the formation of the internal knowledge networks and internal research on education.

Changes in the curriculum

The major renewal in the curriculum consists of a change from a theoretical, scientifically oriented curriculum to a curriculum that is oriented towards scientific professional training. The concept of contextual learning is chosen, since learning that takes place in a context resembling the future environment of professional performance generates more successful learning. A fundamental element of contextual learning in this curriculum is an early internship. This is advanced from the traditional fifth year to the third year of the curriculum. In order to prepare students for this, the first two years of the curriculum have to incorporate practical professional training ('clinical line education', apprenticeships and skills education) besides a more theoretical education. In later years there is more room for theoretical reflections on practical professional experiences from students ('theoretical line education'). The faculty is the only one on a national level that has internships at such an early stage of study. Internationally only two or three other faculties work with early internships, but do not follow the other concepts.

Results

The introduction of the new curriculum was realized within the proposed time span (within 3 years, whereas it took other universities more than 5 years to develop and implement a new curriculum). The developed curriculum is recognised both nationally and internationally to be a prominent one, since it features a number of 'breakthrough concepts' in its programme. The concept of a Z-curriculum and early internships especially are gaining much acclaim both at the national and the international level. After the introduction of the new curriculum, the faculty rises in terms of students' preferences from fifth to second place on a national level. It was not researched whether this was due to new curriculum changes, but it seems that there may be a link. In general future students react very enthusiastically towards the possibility of obtaining ac-

tual professional experience at such an early stage in their study. Now that the new curriculum is developed, a 'knowledge centre' is created in which experiences with the new curriculum are collected and evaluated. The centre serves as an internal (and external) knowledge centre for maintenance of the curriculum from which new developments in the curriculum are initiated and managed.

5.1.2 Within-site analysis case medical education

A. Success and character of the innovation

The innovation can be considered successful, since there is a positive result on 3 of the 5 mentioned characteristics:

Case Medical Education	Criteria	Description	Result
	<i>Possibility to implement</i>	Implementation was realized	Positive
	<i>Duration of life</i>	The innovation is relatively new; it is now in the second year of execution. There are no reasons to suggest that it will be abdicated in the short term	Unknown
	<i>Realization of goals</i>	Initial goals have been realized: the introduction of the original concept on learning in medical education and the contribution towards development of the professional field	Positive
	<i>Considered a success by relevant others</i>	The innovation is considered successful by relevant others	Positive
	<i>Realized pay offs</i>	It is not certain whether it has improved market share	Unknown

Display 5.1-Medical Education I: Degree of success

The innovation can be characterized as a radical innovation, since there is a positive result on 4 out of 4 mentioned characteristics:

Case Medical Education	Criteria	Description	Result
	<i>Basis for developments</i>	It forms the basis for subsequent developments and incremental innovations	Positive
	<i>New insights in the professional community</i>	It is considered as a new concept within the professional field (at least on a national level); others in the professional field are studying the innovation and considering adoption	Positive
	<i>Generalization to the professional community</i>	It has been generalized to the wider professional community	Positive
	<i>Status in the professional community</i>	It has led to improvement of the professional status	Positive

Display 5.2-Medical Education II: Character of the innovation

Learning model and information processing activities

In general the learning model and information processing activities in this case can be summarized as follows:

Case Medical Education	Reflection/ Abstractive processing	Experience	Information processing activities	Learning style	Goal orientation
Description	Reading and writing leads to new ideas. The model fits perfectly in a new theoretical framework.	I act on the basis of my own experience and reflection upon this. I used my own practical experience to implement it.	We develop concepts into application. It is a continuum, everybody takes a step and uses the experiences from others and goes a step further.	I developed some models on the basis of what we saw elsewhere. We used the idea that failed elsewhere and incorporated it in such a way that we succeeded.	It is a challenge to do something new; integrate theory. Give us the problem and we will solve it
Result	High/medium	High	High/medium	Boundary Spanning/ Experiential	Personal knowledge building Problem solving

Display 5.3-Medical Education III: Learning model and information processing

There are differences in the used learning model according to the role and position of the actor in the innovative process:

The external circle/strategic circle is characterized by:

- *High levels of reflective and abstractive processing:* Based on either a strong ‘self-propelling’ way of reflective and abstractive processing, leading to development of ones own contours and concepts for innovation on the basis of collected information and views. Or strongly influenced by literature and theoretical models underlying the concept.
- *Medium levels in the use of experiences:* Mostly based on experiences from the innovators’ own setting (which lies outside the organisation) and experiences from others, which lie both inside and outside the professional field. Experiences from ones own organisation are in a certain way considered as slowing down the process of innovation.
- *High in information processing:* Both high in acquisition of information on both a theoretical level and a more experience-based level (within and outside the professional community) and strong in interpretation and distribution of this information and in application (translating the knowledge into the core concept for the innovation.
- *An experiential and a boundary spanning learning style:* The learning style is a mixture between an experiential and a boundary spanning style. In this mixture ideas that failed in other organisations are placed in a new context and successfully developed and implemented. Also ideas from other frames of reference are used for the developmental process.
- *A personal development goal orientation:* Developing new views is considered a way of life.

The strategic circle is characterized by:

- *Medium reflective and abstractive processing:* Actors are either medium in reflective and abstractive processing, using their own experiences and reflections upon these; or they are lower in reflective and abstractive processing. Internalizing the concept underlying the innovation but working from a more practical base.
- *High experience:* Actors are strongly using their own experiences in the developmental process.
- *High/medium in information processing:* The members of the strategic circle differ on this variable, being either high in knowledge acquisition from elsewhere, in interpretation of this knowledge and in distribution of this information, but less strong in application. Or being low in knowledge acquisition, but strong in distribution and application of knowledge acquired by others.
- *Diverse learning styles:* Depending on the phase of the innovation the learning style differs from experiential and boundary spanning to boundary spanning and continuous improvement.
- *Problem-solving goal orientation:* The dominant goal orientation is problem solving.

The internal circle is characterized by:

- *Low/medium reflective and abstractive processing:* Focussing on implementation of developed concepts rather than on reflective and abstractive processing.
- *High experience:* Using mostly their own experiences in the implementation and developmental process.
- *Information processing:* The role of information processing is generally *low in knowledge acquisition and interpretation, high in application and high-low* in distribution.
- *Boundary spanning/continuous improvement learning style:* The learning style is a mixture between boundary spanning (how are others doing this) and continuous improvement in the implementation of the developed concept.
- *Problem solving/task oriented goal orientation:* The goal orientation differs between problem solving and completion of a given task.

B. Actors

In general it can be stated that there are three groups:

- An *external circle* consisting of members of the faculty (mainly the innovator and the chairman of the faculty board, although the dean also played a role) and of members of other faculties in the country. They are all professionals who occupy themselves with the development of medical curricula and/or are responsible for the curriculum in their faculty.
- A *strategic circle* consisting of a number of members of the faculty. Most members of this group have no direct managerial responsibility but are highly respected peers from the professional group in the organisation (working on a high level in their own professional field). The group is selected on the basis of representing different professional groups with differing interests. The group is also selected on the basis of the fact that they

see the medical curriculum as an important issue. This group also includes the vice-dean of the faculty (who has both a managerial position and is a highly respected member of the professional group).

- An *internal circle* consisting of members of the faculty who have a role in different working groups which work on the elaboration and implementation of different aspects of the curriculum. The project manager is also considered a member of this group.

There are several linking pins, as some actors are members of more groups. The statements in their interviews are analyzed according to the role to which they refer.

C. Socio-political processes

In general the political process can be summarized as follows:

Case Medical Education	Between groups			Within Groups		
	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Description	The others were very constructive, open and willing to share their knowledge. The curriculum committee holds on to their ideas.	I select the others on their knowledge. We all share our latest developments.	They share in vision development and evolution of ideas. We share our ideas.	We selected them because of their identification with education. Some are closed, others more open, but all were asked because of their experience.	We developed the concept with this group. Sometimes they are rather dogmatic, they stick to their own ideas.	In a certain sense there is a dialogue, but in the other sense there is not. We investigate, but still the leaders whine about their ideas.
Result	Open/closed	Open	Open	Open/closed	Open/closed	Open/closed

Display 5.4-Medical Education IV: Political processes

The socio-political process also differs depending on the composition of the dominant group and the role of the group in the innovative process.

The political processes between the different groups can be described as follows:

- External circle-strategic circle: Open in terms of information exchange and foundations for the relation and character of the communication.
- Strategic circle-internal circle: Open in terms of information exchange, although it concerns mostly a one-way information exchange, where others have to be convinced in terms of the model that is chosen. In this sense communication is also closed, since it is based on assumptions underlying the chosen concept rather than on terms of investigation and dialogue between the strategic circle and the internal circle. There are no clear state-

ments concerning the foundation for the relation (influenced by existing coalitions or added value) between the strategic circle and the internal circle.

The political process within the different groups can be described as follows:

- The external circle: Varying between open and closed in relations, being closed in selection of the members in the groups but open in sharing mutual developments. The major base for group binding seems to be mutual development of knowledge. It is open in terms of goal orientation and attitudes. In general there is an inquisitive culture and the group aims at knowledge development rather than preservation of the existing body of knowledge.
- The strategic circle: Moves during the process from open to closed. They start with open relations, goal orientation and attitudes in the process of collective investigation and discussion of the viewpoints and concepts concerning the new curriculum. Selection of the group becomes more closed, because it is based both on following existing power balances and on the added value of members. Once the central concept is chosen and the innovations that fit in with the concepts are selected, the political process within the group becomes more closed. The process focuses on enhancement, improvement and ‘sales’ of the concept and innovation.
- The internal circle: Varies between closed and open. Relations in the group are open; selection is on the basis of added value. The group is geared toward development of new insights that can help the implementation of the innovation. The goal orientation is both closed and open, closed in terms of commitment to its task but open in terms of the development of knowledge and methods about the way the innovation can be implemented. The attitudes are, within the frame of the concept and innovation, open at a start, but become, due to time pressure more closed in the end.

D. Organizational conditions

There are not a lot of data in the interviews and documents to generate results about the organizational conditions needed for innovation. On the basis of the available information it can be concluded that:

Case Medical Education	Room for reflection and meta-cognitive Ability	Stimulation of participation in knowledge networks
Description	In the beginning of the project there was time for reflection, but now the train is high on steam. In general, management is not very open to new, deviating ideas.	Some new ideas that were brought in we did discuss but did not introduce them. Introduction of the chairman of the faculty board was deliberately done to introduce both power and high-level proven knowledge about educational insights.
Result	Medium to low	Low

Display 5.5- Medical Education V: Organizational conditions

- *Medium to low room for reflection and meta-cognitive activity:* There is room at the beginning of the project, when a view on the problems at hand and a possible new concept is developed. Later on time pressure increases; consequently there is no more room for fundamental reflection and metacognition.
- *Low stimulation of participation in knowledge networks:* There is no deliberate stimulation or facilitation by management to participate in knowledge networks as far as the subject of the innovation and the innovative process are concerned.

5.2 RESULTS CASE SOCIAL SCIENCES

5.2.1 Case description Social Sciences

The Faculty of Social Sciences of University Utrecht consist of several departments and curricula, i.e. sociology, psychology, education, economics and anthropology. The innovation concerns the transformation of all curricula. The original idea behind the transformation is the integration of all curricula into one large educational program integrating all the social sciences. This gives students the possibility either to follow a more general program or a more differentiated program in the social sciences. After several alterations in plans during the innovation process, the innovation is restricted to the introduction of a combined first year program ('the gammapropaedeuse') for the relevant curricula. In this plan students choosing a study in one of the social sciences follow a collective first year, partly oriented towards social sciences in general (collective program) and partly oriented towards the chosen discipline (differentiated program). The original curricula are transformed from a 4 year disciplinary program into a 1 year general + 3 years disciplinary program.

Causes for change

There are several phases in the innovation process; the causes for the innovation vary in each of these phases. Originally there are both internal and external reasons for innovation. The internal drive originates from a group which, from a society-oriented view, wants to introduce a new concept for the social sciences. This group strives towards realization of the ideological viewpoint in which all human and societal sciences are integrated in terms of content and in terms of scientific, educational and societal developments. In order to realize this, theoretical and methodological viewpoints are integrated with a problem- and field-oriented approach (theoretical, methodological and thematic pluralism'). Externally there is the pressure of closure of the psychology department that can be averted by introducing a new concept for the curriculum (the 'gammapropaedeuse' was part of a deal with the government to prevent closure of the psychology department). In the second phase the drive for innovation is caused by the wish to develop a program based on the Anglo Saxon bachelors-masters model, which gives students the opportunity both for broad development and for a broadened orientation for their final professional choice. In the third phase, there is on one side the motivation to improve educational techniques and the contents of the program and on the other side the motivation to make the different disciplinary curricula in the faculty comparable to the disciplinary curricula in other universities (notwithstanding the fact that there is a separate multidisciplinary first year).

Innovation process

As the reasons, contents and contexts for the innovation plans change during the process, there is no straightforward innovation process. The major cause for this is that at different moments in the process other groups with diverging approaches and conflicts of interests play a central role (both in terms of execution and in terms of governance). There are three major phases in the development and implementation process.

First phase: ideology

This phase is dominated by ideological views, which claim that the existing differences between the social sciences are coming to an end and a new unifying broad social science will emerge. In this phase a first layout for a unifying program for all curricula in the social sciences is developed. Although some plans are partly implemented in this phase, there is no total and whole-hearted acceptance of the plans. Different groups oppose the plans, and at the top management level there is ambivalent support.

The core team in this phase had no strong links with the rest of the faculty. Communication is closed and aimed at convincing others about ideological viewpoints rather than of investigating opinions. There is no external knowledge acquisition as ideas are developed inside-out by the core team. There is no alignment on the ideological view of the 'new social sciences'; nor is there mutual engagement in terms of anchoring this vision and concept within the academic community. A number of different disciplinary groups don't incorporate the changes and ideology behind it; other disciplinary groups do.

Second phase: pragmatism

This phase focuses on establishing a compromise between the plans resulting from the first phase and the conflicting interests and opinions among the different disciplines. The original plan is changed and reduced in the sense that only the plans for the first year of the curriculum are developed and introduced. Plans for the succeeding years are abolished. The resulting plan for the first year is less interdisciplinary in character than originally intended and gives room for disciplinary profiles. In this phase the actual development and acceptance of the *gammapropaedeuse* is realized. Central in this phase is one person, the new dean of the faculty. By himself he develops the new plans and takes care of acceptance. There is no clear external community or network that plays a role in the development and introduction of the plans, although the dean is influenced by several external groups on scientific education in which he has a central role.

The style of communication by the dean is more open than the communication by the strategic group in the first phase, but it does not result in the formation of an internal group(s) or network that accepts and supports the changes and concepts behind it. The developed concepts are therefore not shared by the different groups within the faculty. The concepts are accepted as they seem to solve the problems that emerged in phase one and as the dean is able to negotiate between the clashing interests of different coalitions within the faculty.

Third phase: implementation

In this phase a struggle develops between a small core group striving for adequate implementation of the *gammapropaedeuse* on one side and leading professionals from different department rejecting the program on the other side. Some of these last groups are supported in their struggle

by official professional associations (e.g. in the form of negative visitations). After nine years this strife leads unexpectedly to the final abolishment of the gammapropaedeuse.

When the gammapropaedeuse really starts all persons with strategic positions from phase 1 and 2 have relinquished their positions. A small group, consisting of staff members (below the level of professor), is formed that is responsible for supervision of execution and further development of the program. Due to the composition of this group and the departure of responsible persons from phase 1 and 2, there is no link between the supervisory group and persons or groups in strategic positions. There is no group with a strategic position that supports the program. As a consequence it is very hard to actually realize the gammapropaedeuse in the way it was intended. Some incremental innovations in the educational methods of the program are developed. These are accepted and appreciated by the different coalitions within the faculty but do not lead to acceptance of the gammapropaedeuse. The incremental innovations are abandoned with the abandonment of the gammapropaedeuse.

Changes

Radical innovations and changes are planned, but only a (minor) part of these are actually implemented: a one year gammapropaedeuse that serves as an integrated broad orientation on the social sciences. The program consists of a collective (integrated social sciences) and a differentiated (orientation on different disciplines) program. Within the program several innovations in educational methods and methodology are introduced.

Organizational structure and culture

There is no strong organisational context for the process of innovation and renewal. There is no clear strategy for the management of the process. Knowledge developed in the process is not structured and used for further developments. The organisation forms no part of an external community of practice or a network related to the innovation.

Results

The results of the gammapropaedeuse are differentiated:

- In the first years after the introduction of the program there is a substantial increase in the number of students choosing Utrecht University for a study in the social sciences.
- According to the psychologists the quantity of students increases, but the quality decreases (no students with a primary choice for psychology, but doubters).
- Student advisors at 'delivering high schools' are positive about the changes, especially the broad orientation and the possibility for students to delay their choice for one of the disciplines in the social sciences.
- The psychology department can be maintained.
- The image of the gammapropaedeuse differs in the various disciplinary communities on a national level but is more negative than positive. Professional associations in the field of psychology are especially negative. It appears to be harder for the Utrecht Psychologists to participate in national research programs.
- The formal evaluations of the program by various disciplinary evaluation committees differ from positive (sociology, education) towards ambivalent (anthropology) and negative (economy and psychology).

- The original plan of a 3 year integrated social sciences program is abolished. Later on the gammapropedeuse is restricted to only a partial collective program.
- After nine years the whole program is abolished and the original disciplinary program for the different disciplines is restored.
- The changes are not used as an example for curriculum renewal and received little if any attention in the professional field.

5.2.2 Within-site analysis Social Sciences

A. Success and character of the innovation

The innovation cannot be considered successful, since there is a positive result on less than 3 of the 5 mentioned characteristics:

Case Social Sciences	Criteria	Description	Result
	<i>Possibility to implement</i>	Implementation was realized and the innovation was executed during 7 years	Positive
	<i>Duration of life</i>	The innovation was changed and reduced in concept before and after implementation; from the original concept of a new program that would last years only the first year was introduced. This first year was constantly reduced to a minor variant of what was originally intended. In the 7 year period of realization there were constant threats of abolishment.	Medium negative
	<i>Realization of goals</i>	Initial goals were diverse. The goals for the innovation changed during the process. Some goals have been realized (prevention of closure of one of the departments). Other goals were not realized (the development and realization of a new and interdisciplinary view on the social sciences).	Medium
	<i>Considered a success by relevant others</i>	The innovation was not considered successful by relevant others both within and outside the organization. Some groups stated explicitly that the innovation had negative effects.	Negative
	<i>Realized pay offs</i>	It led to a sustainable increased market share.	Positive

Display 5.2- Social Sciences I: Degree of success

Due to its' failure the innovation cannot be characterized as a radical innovation, since there is a positive result on less then 3 of the 4 mentioned characteristics:

Case Social Sciences	Criteria	Description	Result
	<i>Basis for developments</i>	It did not form the basis for subsequent developments and incremental innovations.	Negative
	<i>New insights in the professional community</i>	It is not considered as a new concept within the professional field (at least on a national level). It was in general considered by the relevant field as a negative development. Some relevant others saw it as a positive development, but have not adopted the innovation.	Negative
	<i>Generalization to the professional community</i>	It has not been generalized to the wider professional community.	Negative
	<i>Status in the professional community</i>	It has not led to improvement of the professional status.	Negative

Display 5.2- Social Sciences II: Character of the innovation

B. Learning model and information processing

In general the learning model and information processing activities can be summarized as follows:

Case Social Sciences	Reflection / Abstractive processing	Experience	Information processing activities	Learning style	Goal orientation
Description	Due to external forces they could get some elements to support the original concept. Some people were theoretically inspired, others were more pragmatic.	I used my experiences from the governmental advisory committee. We made evaluations and improvements on that basis.	I did not have the impression that there were external sources that played a role. The whole educational approach was greatly enhanced when the dean started participating.	Within the margins of what was possible the dean got the best out of it. We made evaluations about what went right and what went wrong and how to improve while retaining the strong points.	It was solving a problem by making a deal with the government. When I arrived here it was a big mess, and I tried to solve it by a more pragmatic approach.
Result	Medium/low	Medium	Low/medium	Continuous improvement	Problem solving

Display 5.2- Social Sciences III: Learning model and information processing

There is no relevant external circle in this project. There are however two subsequent strategic circles. The results are analysed for these two strategic circles and the internal circle.

Learning model and information processing activities differ for the circles:

The first strategic circle is characterized by:

- *Medium levels of reflective and abstractive processing:* There is certainly an ideological view behind the innovation. The ideology shows however no clear link to reflections on the relevant field but is stated as a general societal view that is translated to the work process in the organization. There is no reorganization of the knowledge base for education.
- *Medium to low levels of experience:* The ideology is never tested or evaluated on the grounds of practical experience within or outside the organization. The innovation is not rooted in the actual work processes or discussed in terms of existing theories of practice.
- *Low information processing activities:* There is, apart from the more general ideological view, no knowledge brought in from outside. There is hardly any knowledge interpretation, distribution and application.
- *No clear learning style:* There is no style in learning that fits in with any of the descriptions we used.
- *A problem-solving goal orientation:* This orientation is geared towards the solution of diverse problems (varying from a more problem-oriented approach of science to the prevention of closure).

The second strategic circle is characterized by:

- *Medium to high levels of reflective and abstractive processing:* Fitting in the original idea to other views on the design of curricula.
- *Medium to low use of experience:* Experiences used are principally based on experiences in other settings and much less on experiences in the actual work process, although experiences with the innovation are also used.
- *Medium information processing:* High in knowledge acquisition from other settings, high interpretation of this knowledge, lower in distribution of this knowledge, but high in application.
- *A boundary spanning learning style:* Using ideas from other countries and applying these to the situation at hand.
- *A problem solving goal orientation:* Geared to the solution of different problems.

The internal circle is characterized by:

- *Low to medium levels of reflective and abstractive processing.*
- *Medium to high levels of use of experiences.*
- *Medium to low information processing:* Low in acquisition and interpretation, medium in distribution and application.
- *An experiential and a continuous improvement learning style.*
- *A problem solving goal orientation.*

C. Political processes

The political processes can be summarized as follows:

Case Social Sciences	Between groups			Within Groups		
	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Description	There was no collective agreement between groups. We were forced to do it.	The groups in the faculty never accepted the ideas behind the plan. It was all manipulated and they all remained independent in their attitudes.	There was no cooperation and communication. The board could not manage the view of the department. There was communication targeted at convincing us, not geared towards integrating other viewpoints.	There was a small group that went on very well together. It was a rather lone-some activity, that of this working group.	The group tried to develop new ideas and knowledge. There was never any support from the university and faculty board.	The university is a very closed and conservative institution. On the practical level we learned a lot and had respect for each other.
Result	Closed	Closed	Closed	Closed/open	Closed/open	Closed/open

Display 5.2- Social Sciences IV: Political processes

The political processes between the different groups can be described as follows:

- In the first strategic group political processes with the rest of the faculty are closed.
- In the second strategic group political processes between this group and the faculty are in general closed, but more open in terms of one-way information on the developed plans.
- Communication between the second strategic circle and the internal circle is closed.

The political processes within the different groups can be described as follows:

- Within the first strategic circle political processes are closed, the group is formed on the basis of positions and power balances and on the basis of agreement with the concept. In this context discussion is open. The group is mostly defensive in attitude.
- Within the second strategic circle the dean has a very dominant position and selects the other members on the basis of positions. The group is closed in goal orientation and attitude, but becomes less defensive over time. Plans are changed on the basis of other views that are introduced.
- The internal circle moves from closed political processes to more open processes.

D. Organizational conditions

There is not a lot of data in the interviews and documents to generate results about the organizational conditions needed for innovation. On the basis of the available information it can be concluded that:

Case Social Sciences	Room for reflection and meta-cognitive ability	Stimulation of participation in knowledge networks
Description	Leadership was open to new ideas, sometimes they used them, sometimes not. There was no room for problem analysis and for reflection.	There was no collaboration, no sharing of knowledge; later it became a bit better. I tried to share knowledge by reporting on what had happened on the basis of evaluations, but there was never any reaction to it.
Result	High-medium to low	Low

Display 5.2- Social Sciences V: Organizational conditions

- *Varying room for reflection and meta-cognitive activity:* Only two respondents answer question on room for reflection and meta-cognitive ability; their answers vary from high to medium (one respondent) to low (one respondent).
- *Low stimulation of participation in knowledge networks:* There is no deliberate stimulation or facilitation by management to participate in knowledge networks as far as the subject of the innovation and the innovative process is concerned. One respondent points to deliberate neglect of attempts to create internal knowledge networks.

5.3 CROSS CASE ANALYSIS

Further data-reduction is required for comparison among the cases. This reduction is realized by creating cross-case displays, comparing the two cases from the same organization. The displays contain summaries and conclusions from the within-side displays. In this way within the same organization a successful radical innovation and an unsuccessful innovation (intended as radical) can be compared. The labels that are used are high, medium and low in the case of reflective and abstractive processing, experiences and information processing activities. The labels 'high and medium' and 'medium and low' are also used in combination. The first stated label shows the dominant tendency on this stated variable. In the political processes the terms 'open' and 'closed' are used. They are also used in combination in the same way as the other labels are used (with the first label stating the dominant tendency).

Case	Reflection/ Abstractive processing	Experience	Information processing activities	Learning style	Goal orientation
Medical Education	High/medium	High	High/medium	Boundary Spanning/ Experiential	Personal knowledge building Problem solving
Social Sciences	Medium/low	Medium	Low/medium	Continuous improvement	Problem solving

Display 5.3-Cross Case Analysis I: Learning model and information processing

Case	Between groups			Within Groups		
	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Medical Education	Open/closed	--	Closed/Open	Open/closed	Open/closed	Open/closed
Social Sciences	Closed	Closed	Closed	Closed/open	Closed/open	Closed/open

Display 5.3- Cross Case Analysis II: Political processes

Case	Room for reflection and meta-cognitive ability	Stimulation of participation in knowledge networks
Medical Education	Medium to low	Low
Social Sciences	High-medium to low	Low

Display 5.3- Cross Case Analysis III: Organizational conditions

6. CONCLUSION AND DISCUSSION CASE STUDIES MEDICAL EDUCATION AND SOCIAL SCIENCES

This chapter presents a first preliminary discussion of the variables and their constituting elements and a confrontation of the propositions with the findings from the two first case studies. The discussion we present is not primarily aimed towards a full fledged consideration of the research questions, the conceptual models and the propositions. It is mainly aimed towards a refinement of the variables, propositions and the development of a more mature process model for the creation of radical innovations in KISFs. We do this on the basis of the findings from the case Medical Education and the case Social Sciences and a subsequent discussion of additional background literature.

This discussion is the first step in the cycle towards the final development of a process design model for radical innovations in KISFs. The next steps are presented in the succeeding chapters.

6.1 CONCLUSIONS

The main variables to be examined are: radical innovation (success and function), reflection and abstract conceptualisation, experiences, information processing activities, learning style, goal orientation, socio-political process (this last refined into processes between groups and processes within groups), room for reflection and meta-cognitive activities and stimulation of participation in knowledge networks.

6.1.1 Function and success of the innovation

Innovation: function and success

The cases Medical Education and Social Sciences differ both in terms of the degree to which the innovation was radical and the degree to which the innovation was successful. The case Medical Education is considered to be an innovation that is both radical and successful. The case Social Sciences is considered to be an innovation that is not successful and that was never the radical innovation that it aimed to be.

From our first findings it appears that there is some overlap between the degree of success and the degree of radicality of the innovation. Due to our definition of the variables the fact whether the innovation is radical is (partly) determined by the fact whether the innovation is successful. The opposite is not the case. Success is not determined by the degree to which the innovation is radical as incremental innovations can also have a positive score on the degree of success. The degree of success is determined by the possibility to implement, the duration of life, realization of goals, realized pay offs and considered success by relevant others. The degree of radicality is determined by the fact whether the innovation is a basis for new developments, leads to new insights in the wider professional community and can be generalised to that community, and the improvement of the professional status of the firm. All the factors that describe radicality are (partly) determined by whether the innovation can be implemented and whether it has had a certain duration of life (degree of success). As such we can conclude that there is an interdependence between the degree of success of the innovation and whether the innovation is considered

radical, where unsuccessful innovations will tend towards a lower score on the degree of radicality.

6.1.2. Learning model

Reflection and abstract conceptualization

In the successful case Medical Education reflection and abstract conceptualization was high to medium, whereas in the unsuccessful Social Sciences case there was medium to low reflection and abstract conceptualization. This points to a moderate positive influence of reflection and abstract conceptualization on the outcome of the innovative process.

From the findings it can be concluded that reflection and abstract conceptualization has a strong role in the first stages of the process and is reduced later in the process. In these first stages reflection and conceptualization, also based on experiences in other contexts, seem to be used in order to develop ideas and an underlying concept for the innovation. In this sense there is a focus on reflection and concept-building, as such we will rename this variable 'reflection and conceptualization'.

Experiences

In the case Medical Education there is high use of experiences, the use of experiences in the case Social Sciences is low. This points to a positive influence of the use of experiences on the outcome of the innovative process.

The use of experience is relatively low at the start of the process, but comes at its height during later phases, where the innovation is translated to actual products and services. There seems to be a role for experience in translating the product concept to actual products and activities.

Learning style

In both cases the dominant learning style is boundary spanning. In the case Medical Education this learning style is combined with an experimental learning style. In the case Social Sciences the learning style is not very clear but points to boundary spanning in combination with continuous improvement. This points to a positive influence, especially concerning the experimental learning style, on the outcome of the innovative process.

In the process the learning style shifts from boundary spanning and experimentation in the first phases towards boundary spanning and continuous improvement in later phases.

Goal orientation

In the case Medical Education the goal orientation is based on a combination of problem solving and personal knowledge building. In case Social Sciences the orientation is aimed at problem solving. It is not clear whether the fact that the innovation was geared towards the solution of diverse problems was a significant factor in the failure of the innovation. In general terms there seems to be a positive influence of a personal knowledge building goal orientation and a focused problem solving style on the outcome of the innovative process.

In the process the goal orientation shifts from personal knowledge building and problem solving in the first phases towards problem solving and task orientation in the later phases.

6.1.3 Information processing

In the case Medical Education the information processing activities vary between high and medium, tending towards high. In the case Social Sciences information processing activities vary between low and medium tending towards low. This points to a positive influence of information processing activities on the outcome of the innovative process. The influence seems to be relevant to all aspects of information processing: knowledge acquisition, knowledge distribution and knowledge application.

In the first phases of the process the stress for information processing activities is on knowledge acquisition from outside, during later phases the stress is replaced on knowledge distribution and application within the organization. This seems to parallel the shifting stress from reflection and conceptualization towards the use of experiences

6.1.4 Socio-political processes

Between groups: information exchange

In the case Medical Education the information exchange varied between open and closed, with a more open tendency. In the case Social Sciences the information exchange varied between closed and open, with a more closed tendency. In general it seems there is a positive influence of open information exchange on the outcome of the innovative process.

It seems there is a tendency for the information exchange between groups to move from open to close during the innovation process: an open exchange between external groups and strategic groups and a more closed exchange between the strategic groups and the internal groups. The exchange gets more closed and becomes more one way as the concept for the innovation crystallizes.

Between groups: Foundations for relation

There is no clear picture on the foundation for the relation between different groups in the case Medical Education. In the case Social Sciences the foundation for the relations was closed in character. As such is it not clear what the role of foundations for relations (based on existing coalitions or added value) on the innovative process is.

Between groups: Character of communication

The character of communication within the relevant groups starts with dialogue and open communication in the external group in the case Medical Education, but is closed for the strategic group and internal group, as the character of communication focuses on the implementation of the developed concept. In the case Social Sciences the character of communication is generally closed. In general the positive influence of open communication on the innovative process is mainly relevant at the start of the process. In later stages the influence is less clear.

It seems the character of communication closes down as the major concept for the innovation is developed, leaving only room for communication within the chosen frame of reference and subsequent assumptions.

Within groups: Relations

Relations within groups vary from open to closed in the case Medical Education and from closed to open in the case Social Sciences. In general there seems to be a positive influence of open relations within groups in the outcome of the innovative process.

There is no clear picture on the changes in relations within groups during the different phases of the process. It is important to note that different groups play a dominant role in the phases and thus the data from different groups were analyzed.

Within groups: Goal orientation

Goal orientations in the different groups in the case Medical Education differed between open and close with a tendency towards open goal orientations (development of new knowledge and methods). In the case Social Sciences the goal orientation was slightly more closed in character. There seems to be a light positive influence of an open goal orientation towards the outcome of the innovative process.

There is no clear picture of the changes in goal orientation within the different groups during the different phases of the process.

Within groups: Attitudes

The attitude in the different groups in the case Medical Education varied between open and closed, tending towards more open. In the case Social Sciences the attitude varied between closed and open, tending towards more closed. In general there seems to be a light positive influence of attitudes on the outcome of the innovative process.

In the case Medical Education the attitudes changed from open to closed, during the process. With a stronger closed focus on the chosen concept in the later stages. In the case Social Sciences a reverse movement took place, opening up discussions and moving towards a more investigative and entrepreneurial attitude, in the later stages of the process.

6.1.5 Organizational conditions**Room for reflection and meta-cognitive abilities**

In the case Medical Education there was medium to low room for reflection, where the room for reflection closed down as the project proceeded. For case Social Sciences little information is available on room for reflection and meta-cognitive abilities. The information that is available shows a diffused picture for the different actors and groups.

Stimulation of participation in knowledge networks

In both cases there was little deliberate stimulation by management for knowledge workers to participate in knowledge networks. There also seems to be no strong relation between stimulation by management and actual participation in knowledge networks by knowledge workers. In the case Medical Education participation is high, with no strong stimulating role by management and in the case Social Sciences participation is low, with no strong stimulating role by management.

6.2 FINDINGS RELATED TO PROPOSITIONS

In this section we give a first impression of the findings in the context of the propositions as formulated in chapter 3. We confront our propositions with the empirical results from our two case studies.

1. *The creation of radical innovations in KISFs are based on both the experiences from the primary process by professionals and the reflection and conceptualization on the basis of these experiences*

This proposition seems to hold for our two first cases. On the basis of the findings, it has to be remarked, that the role of experience and reflection and conceptualization differs in the different stages of the innovative process. A positive relation on the outcome of the innovative process is found in the case where reflection and conceptualization is moving from high to low during the process and the role of use of experience is moving from low to high.

2. *The creation of radical innovations in KISFs are based on the reflection and conceptualization of experiences in the daily process coupled to the output of information processing activities that take place in the context of the innovative process*

This proposition was not tested as such. However, there are some findings related to this proposition:

- There was no clear relation between reflection and conceptualization and the use of experience, as the role of these two variables varied during the process (see proposition 1).
- There is a strong role for information processing activities in the innovative process.
- When the different phases in the innovation process and the activities of the different groups are taken in account there seems to be a relation between:
 - Reflection and conceptualization and the process of knowledge acquisition, where there is a positive effect of these simultaneous processes on the outcome of the innovative process. In the successful case there was a focus on these two processes during the first stages of the innovative process.
 - The role of experience and the process of knowledge distribution and application, where there is a positive effect of these simultaneous processes on the outcome of the innovative process. In the successful case there was a focus on these two processes during the later stages of the innovative process.

3. *The creation of radical innovations is based on cognitive and meta-cognitive activities that lead to reflection and abstraction of action and experience by professionals in the firm*

There are no direct research findings related to this proposition as the level of meta-cognitive activities was not measured. There is, however, a relation between the findings and our first proposition. It can be stated that there is a focus on reflection and abstraction during the first stages of the process, but there are no clear-cut data to relate this to the amount of either cognitive or meta-cognitive activities. A general finding in the research, however, shows that reflection and abstraction of action and experience require meta-cognitive processing. As such we can suppose

on the basis of the findings related to the first proposition, that cognitive and meta-cognitive activities take place, especially during the first stages of the innovative process.

As there is a strong relation between this and the first proposition we want to abandon this proposition for the rest of our study.

4. *The creation of radical innovations is based on knowledge that resides in the primary process of the firm and knowledge that resides within the wider professional community outside the firm*

The findings seem to confirm this proposition. There seems to be a stronger role for outside knowledge at the start of the innovative process and a stronger role for knowledge residing in the primary process of the firm in the later stages of the process.

5. a. *The creation of radical innovations is based on learning strategies that are experimental in character*

This proposition is confirmed by the findings, with an emphasis on experimental learning strategies in the first stages of the process.

b. *The implementation of radical innovations is based on learning strategies that are boundary-spanning in character*

This proposition is neither confirmed nor rejected, as boundary-spanning strategies are used in both cases.

6. *The creation of radical innovations is based on goal orientations directed towards problem solving and personal knowledge building*

The findings point to a positive confirmation of the role of personal knowledge building in the creation of radical innovations. There is neither a confirmation, nor a refutation, of the role of problem-solving goal orientations in the creation of radical innovations.

7 *The processes that lead to the creation of radical innovations are inhibited by the closed socio-political processes that exist in the KISF*

This proposition is too roughly stated to be answered. A differentiated treatment leads to the following findings:

- The creation of radical innovations is facilitated by open socio-political processes between the different groups. Influential elements are information exchange and the character of information (based on assumptions or based on dialogue). This relation is however not clear cut. In general it can be stated that successful innovative processes are characterized by political processes between the different groups that move from open to closed during the progression of the process.
- The creation of radical innovations is facilitated by open socio-political processes within the different groups. The most influential element is the open relation within the group (ties based on development of knowledge, low compliance to group norms and values and selection of members on the basis of added value); light influences are accounted for

by a developmental goal orientation within the group and an investigative and entrepreneurial attitude. The relations are not clear cut. In general it can be stated that successful innovative processes are characterized by socio-political processes that are open for the external circle and move from open to closed for the strategic circle and the internal circle.

8. *Radical innovations demand organizational conditions where there is room for the development of reflective and meta-cognitive abilities, and for reflection*

This proposition is not confirmed by the research findings when the total process is considered. However, there seems to be a positive tendency between room for reflection and actual reflection and conceptualization as a basis for innovation in the first stages of the innovative process.

9. *Radical innovations demand organizational conditions that stimulate participation in knowledge networks within and outside the organization*

This proposition is rejected as a result of the research findings. There was a positive influence of participation in knowledge networks on the outcomes of the innovative process, but the organization or management played no strong role in this. Knowledge workers appear to be rather autonomous in participation in knowledge networks. The question can be still asked whether there is a role for management related to this, with an emphasis on the facilitation of participation in networks (by providing time, money and opportunity).

Rival propositions:

10. *Radical innovations are formed on the basis of the learning process of social construction in the organization*

This rival proposition was not explicitly addressed. From the findings it can, however, be deduced that there is a strong role for reflection and conceptualization and external knowledge acquisition in the first stages of the innovative process. Both these characteristics are no essential elements of social construction (see paragraph 2.3.3). In later stages the innovative process is characterized more by the reflection and construction based on experiences in the primary processes and by knowledge distribution and application. These stages show more characteristics of a social constructivist process of learning. The question that is relevant for confirmation of the proposition is what phases in the innovative process are essential for the creation of radical innovation. At this moment this question cannot be answered.

11. *Management plays a leading role in the creation of radical innovations in KISFs*

This proposition was also not explicitly addressed. From the findings on proposition 8 and 9 it can be derived that there is no active leading role for management in the process of creation of radical innovations (NB: we are not addressing the issue of the inducement of the start of the innovative process!!), but there is certainly a facilitating role in terms of creation of room for participation in knowledge networks, time for reflection and conceptualization, and opportunity for experimentation and knowledge building processes. This may be a move away from the 'production and target-realization' role that is often granted for management.

6.3 DISCUSSION

One of the major findings of the first case studies is the fact that the innovative process in KISFs is not a process that is constant throughout time. Instead the process can be divided into different phases with different characteristics. This is in line with findings in research on innovation in general (Vracking and Cozijnsen, 1992; Von Krogh et al, 2000). The phases in the innovative process in KISFs seem to follow the pattern of innovative processes in manufacturing firms, but there are two main differences. The first difference is in the phase of research and development, which seems to be less focussed and less 'detached' from the rest of the organization in KISFs in comparison to manufacturing organizations (no separate R&D department that sparks innovation). The second difference lies in the phase which is described in general literature as dissemination (Vracking and Cozijnsen, 1992; Rogers 1995; Von Krogh et al, 2000) or in literature on innovation in curricula as 'maintaining the new order' (Lindberg, 1998). It appears from our first findings that this stage is not as 'rigid' in KISFs as in other organizations, but is characterized more by a process of ongoing innovation, reinvention or knowing by practicing knowledge workers (Blackler, 1993; Cook and Brown, 1999). In general it can be concluded that the phases of the process of radical innovations in KISFs seem to parallel the phases of the development of new technological systems and approaches as described by Tushman and Rosenkopf (1992). They describe the development of new technological systems in terms of periods of technological ferment and the appearance of dominant design, followed by periods of incremental change. In the context of our research we want to describe the phases in successful radical innovative processes as:

- **The idea generation phase:** in which new knowledge is acquired and imported from external networks, and is interpreted and translated into global visions and concepts underlying the innovation.
- **The crystallization phase:** in which the new processed knowledge is translated and negotiated into a concept that forms the core of the innovative process.
- **The evolution phase:** in which the further development of the innovation into concrete products and services and activities takes place within the 'reframed context of the new concept' and incremental innovations are developed on the basis of the new concept.

Although our findings indicate the existence of different phases in radical innovation in KISFs, it is not clear yet whether these phases are sequential and mutually exclusive or can be parallel: is it only possible to enter a new stage when the preceding one is totally finished, or are there certain parallel trajectories, where certain stages have more characteristics of one sort of process than of another sort of process (e.g. idea generation or crystallization)? Newell et al. use in this context the term 'episodes' rather than stages, as it reflects the '*sporadic, iterative and recursive and sometimes discontinuous nature of the innovation process*' (Newell et al, 2002, pp. 145).

On the basis of the distinction between these three phases we want to formulate an additional proposition to our research project:

- *The process of radical innovation in KISFs is characterized by different phases that can be described successively as the idea generation phase, the crystallization phase and the evolution phase.*

In order to refine our conceptual framework and propositions for the next phases of our research, we will give a short evaluation of these phases on the basis of our findings and the literature on these subjects.

6.3.1 Idea generation phase

Crucial in this phase is the importation of new knowledge and the processing of this knowledge in the organization by reflection and conceptualization within the context of the required change. Wenger talks in this context about the process of *imagination*, as the process that “enables us to adopt other perspectives across boundaries and time” and “where we create images of the world and see connections by extrapolating from our [AvP: external] experiences” (Wenger, 1995, p.217). In our study we found that major learning styles and goal orientation in this phase are experimentation and personal knowledge building. Knowledge sources in this phase are predominantly external. Rosenkopf and Nerkar (1999) point in this context to the impact of organizational boundary spanning and radical search, that crosses both organizational and technology boundaries. One main difference between KISFs and manufacturing organizations lies in the fact that manufacturing firms often rely on R&D-departments for the importation of new knowledge. In innovating KISFs the lack of R&D-departments is compensated by participation in external knowledge networks.

In our research there was a dominant role for the external network, in which members of the organization participate, and for a strategic circle consisting of members of the organization with high standing (opinion leaders). Central in the process of knowledge acquisition from the external network is the ‘gatekeeper’ (Dodgson, 1993; Leonard-Barton, 1995). The gatekeeper exposes himself, by participation in the external network, to outside knowledge and acts as a node for disseminating knowledge. The role of the gatekeepers is matched by ‘boundary spanners’, who act as central figures for importation of knowledge into the organization. The importance of co-operation between gatekeepers and boundary spanners is explained by Wenger’s (1998) concepts of peripheral participation and multi membership, in which he states that gatekeepers possess multi membership of diverse communities of practice but are as a consequence often only peripheral participants of these communities and thus have a low legitimacy of membership. As a consequence, it is difficult for them to import new, and deviant, knowledge into the community. Within frame-breaking situations especially, this knowledge is deviant and as a consequence potentially threatening. Due to this the dominant group of knowledge workers in the organization will often not accept the new knowledge (Reed, 1996) It is therefore important that gatekeepers have their counterparts in boundary spanners, who have a more central position in the community of knowledge workers and who have enough status in this community to cater to the importation of new knowledge:

Learning communities have a strong core, but they let peripheral and core activities interact, because it is in these interactions that they are likely to find new experiences and new forms of competence necessary to create new knowledge (Wenger, 1998, pp. 217).

From our first two cases it appears that in order to realize successful knowledge importation, it is important that the political processes both within and between the external network and the opinion leaders in the strategic circle are open.

On the basis of our findings and the relevant literature we want to refine our propositions:

- *The creation of radical innovations asks for reflection and conceptualization in the organization on the basis of externally acquired knowledge in the idea generation phase.*
- *The creation of radical innovations asks for an experimental learning style in the idea generation phase.*
- *The creation of radical innovation asks for a personal knowledge building goal orientation in the idea generation phase.*
- *The influence of open or closed socio-political processes varies during the process of innovation:*
 - *In the idea generation phase the creation of radical innovations is positively influenced by open socio-political processes between and within the relevant groups.*
- *The creation of radical innovations asks for information processing activities that vary during the process of innovation:*
 - *A focus on acquisition and interpretation during the idea generation phase.*

6.3.2 Crystallization phase

Once knowledge is imported and basic ideas about the innovation are formed, a crystallization phase follows. Crucial in this phase are:

- the creation of a core concept that forms the basis for the innovative process and the eventual innovation(s)
- the political processes that take place between different groups and actors, and that cater to the creation and acceptance of the core concept.

The crystallization phase marks a turning point from the more cognitive-oriented idea generation phase to a phase where the emphasis is on political negotiation.

The core concept that is created in this phase is formed out of the images that were created in the idea generation phase (see also Star and Griesemer (1989) on ‘boundary objects’ or Fujimara (1992) on ‘standardized packages’, Brown and Eisenhardt (1995) on vision or Dougherty (2000) on ‘prototypes’). The concept that is developed provides a new frame of reference for the activities in the succeeding innovative process, as it positions the innovative activities into a reframed setting. Eisenhardt and Santos (2002) mention in this context the development of a framework for new mental models and shared language that forms the basis for interpretation, communication and negotiation in the organization. In the innovative process the core concept has the role of alignment, as it is “*coordinating our activities in order to fit in with broader structures and contribution to broader enterprises*” (Wenger, 1998, p. 189). Crucial for the success of the innovation is the fact that the core concept is not ambiguous and is reified by the dominant coalition within professional community. As it became clear from our Social Sciences case, the lack of an agreed-upon core concept led to ambiguity in what innovations needed to be developed, but also led to continuous rejection of the developed innovative products and activities. In order to realize the desired levels of clarity and reification, two processes have to be accomplished in a satisfactory fashion:

- information processing
- socio-political processes.

In terms of information processing it appears from our study that the crystallization phase is high both in terms of acquisition and interpretation of new knowledge and in terms of distribution and application. This fits in with the view that in this stage the focus is on the creation of an absorptive capacity, which is aimed towards the interpretation of acquired and new knowledge in the organization and towards the ability to exploit this new knowledge for the creation of innovations (Cohen and Levinthal, 1990). In this phase in the case Medical Education there was an emphasis on knowledge interpretation in terms of collective processing of imported knowledge, the assimilation of this knowledge in the strategic group and the process of connecting this new knowledge to their own experiences, and finally the formation of a reified core concept (Wenger, 1998). This core concept was then used as a major focal point for the rest of the innovative process.

The socio-political processes in this phase are focused on negotiation between the gate keeper, boundary spanners and possible other opinion leaders and important members of the dominant coalition in order to develop a *reified* core concept. The negotiation takes place between gatekeepers with multi membership, but peripheral positions in the organization and boundary spanners who have no multi membership but have a core position in the community. It is important to note that the position of gatekeepers is not (only) tied to formal positions in the organization (e.g. senior management) but is also tied to informal positions (influential experts and opinion leaders). It seems the boundary spanners have a crucial role in the creation of the core concept both by enhancement of the absorptive capacity in the organization (facilitating the importation of new and deviant knowledge) and by influencing the political acceptance of new concepts. Their influence enables other professionals in the organization to shape a new frame of reference. Eisenhardt and Santos (2002) point in this context to the importance of both a central position in the knowledge network [AvP: gatekeepers] and the position to enhance an absorptive capacity [boundary spanners] as essential to effective knowledge sourcing. It is in the interplay between gatekeepers and boundary spanners that the capacity for effective knowledge is realized. The role of gatekeepers and boundary spanners can be compared to the adopter categories of innovators and early adopters in Rogers' (1995) innovation diffusion model. Rogers describes the innovator as a person whose salient value *'is venturesomeness, due to a desire for the rash, the daring and the risky'* (Rogers, 1995, pp. 264). The value of the early adopter is his capability to act as an *'opinion leader ... and as a role model for many other members of a social system'* (Rogers, 1995, pp. 264). The importance of the different roles may be pointed out by the differences in our two cases. In the Medical Education case there was clarity about the actor who had the role of gatekeeper and (formalized) clarity about the actors who had the role of boundary spanners (the vice-dean and a group of leading professionals). This group was responsible for the creation of the core concept and for the 'sponsorship' of this core concept as a base for the innovations in the organization. In the case Social Sciences there was a continuous change of roles for both gatekeepers and boundary spanners, making political processes very unclear and hampering the creation of a clear core concept.

In the crystallization phase the socio-political processes are open at the time of assimilation and negotiation and close down as the negotiation process is finished and the reified core concept is created. The investigative and open attitude is replaced by one where there is compliance with the core concept, and activities in the organization are geared towards protection of the newly set norms and status quo of the core concept.

On the basis of our findings and the relevant literature we want to refine our propositions as follows:

- *The creation and realization of radical innovations is based on the creation of a reified core concept.*
- *The character of socio-political processes varies during the process of innovation:*
 - *In the crystallization phase the creation of radical innovations is positively influenced by socio-political processes that move from open to closed between and within the relevant groups.*
- *The creation of radical innovations asks for information processing activities that vary during the process of innovation:*
 - *A focus on acquisition, interpretation, distribution and application during the crystallization phase.*

6.3.3 Evolution phase

In the evolution phase the focus is on further development of the core concept into concrete innovative products and services and activities within the 'reframed context of the new concept'. In fact this phase can be defined as an incremental, puzzle-solving technological process (Thushman and Rosenkopf, 1992) that takes place within the renewed frame of reference. In this phase the created absorptive capacity is used to exploit the new knowledge and the frame of reference. The development and creation of innovative 'end products' or 'end services' in this phase also takes place in the context of conforming the work environment and the demands of the primary process towards the new frame of reference (Leonard-Barton, 1995; Coombs, 1999).

From our research it appears that this phase is characterized by a high use of experiences in learning, a lower use of reflection and conceptualization, a combination of boundary spanning and continuous improvement learning styles, and a goal orientation geared towards problem solving and task orientation. The innovative process in this context seems to be rather parallel to the process of social construction as sketched in paragraph 2.3.3 (Brown and Duguid, 1991; Lave and Wenger, 1991). This phase is also characterized by engagement in terms of '*active involvement in mutual process of shared experience and the production of a local regime of competence*' (Wenger, 1998, pp. 184).

Absorptive capacity is enhanced in this phase as members of the organization (in the case Medical Education there was an active internal circle consisting of executive professionals from the organization) in their capacity as future 'users' of the innovation are able to influence the application of the knowledge and creation of actual innovations. Negotiation of meaning takes place as the further development of innovations is tested against the negotiated framework of the core concept. This process is facilitated in the case Medical Education as members of the strategic circle also participate as members of the internal circle. In this sense the concept of multi membership and its capacity for the acquisition and assimilation of new knowledge in the organization is copied within the organization.

Socio-political processes in this phase are closed between the different groups as they are limited within the context of the core concept. Within the internal circle the process moved from open to

closed as the innovative activities took shape (which points to a parallel motion within the strategic circle during the creation and negotiation of the core concept).

On the basis of our findings and the relevant literature we want to refine our propositions as follows:

- *The creation of radical innovations asks for processing of the reified core concept on the basis of experiences from the primary process by professionals in the evolution phase.*
- *The creation of radical innovations asks for a continuous improvement learning style in the evolution phase.*
- *The creation of radical innovation asks for a problem solving goal orientation in the evolution phase.*
- *The influence of open or closed socio-political processes varies during the process of innovation:*
 - *In the evolution phase the creation of radical innovations is positively influenced by closed socio-political processes between groups and open to closed socio-political processes within the relevant groups.*
- *The creation of radical innovations asks for information processing activities that vary during the process of innovation:*
 - *A focus on distribution and application during the evolution phase.*

6.4 RESEARCH MODEL AND PROPOSITIONS REVISITED

On the basis of our discussion we want to present the following revised set of propositions for our research:

1. *The creation of radical innovations in KIFs is characterized by different phases that can be described as the idea generation phase, the crystallization phase and the evolution phase.*
2. *The creation and realization of radical innovations is based on the creation of a reified core concept.*
- 3a. *The creation of radical innovations asks for reflection and conceptualization in the organization of externally acquired knowledge.*
- 3b. *The creation of radical innovations asks for processing of the reified core concept on the basis of experiences from the primary process by professionals in the evolution phase.*
- 4a. *The creation of radical innovations asks for a experimental learning style in the idea generation phase.*
- 4b. *The creation of radical innovations asks for a continuous improvement learning style in the evolution phase.*
- 5a. *The creation of radical innovation asks for a personal knowledge building goal orientation in the idea generation phase.*
- 5b. *The creation of radical innovation asks for a problem solving goal orientation in the evolution phase.*

6. *The character of socio-political processes varies during the process of innovation:*
 - a. *In the idea generation phase the creation of radical innovations is positively influenced by open socio-political processes between and within the relevant groups.*
 - b. *In the crystallization phase the creation of radical innovations is positively influenced by socio-political processes that move from open to close between and within the relevant groups.*
 - c. *In the evolution phase the creation of radical innovations is positively influenced by closed socio-political processes between groups and open to closed socio-political processes within the relevant groups.*
7. *The creation of radical innovations asks for information processing activities that vary during the process of innovation:*
 - a. *A focus on acquisition and interpretation during the idea generation phase.*
 - b. *A focus on acquisition, interpretation, distribution and application during the crystallization phase.*
 - c. *A focus on distribution and application during the evolution phase.*
8. *Radical innovations demand organizational conditions that include room for the development of reflective and meta-cognitive abilities.*
9. *Radical innovations demand organizational conditions that stimulate the participation of knowledge networks within and outside the organization.*

And the rival propositions:

10. *Radical innovations are formed on the basis of the learning process of social construction.*
11. *Management plays a leading role in the creation of radical innovations.*

On the basis of the discussion of our first cases we want to revise our conceptual framework into the following model:

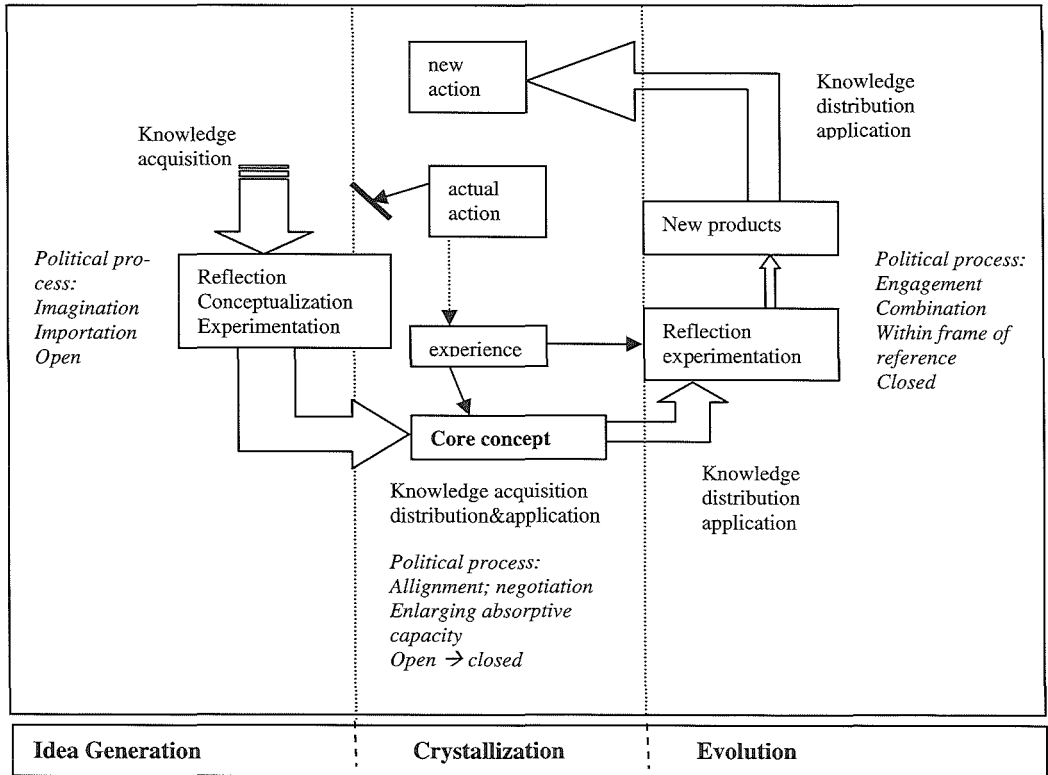


Figure 6.1: Revised model (I) for radical innovations in KISFs

7. RESULTS CASE STUDIES

In this chapter we will present the results from the different case studies. The focus of the first part of this chapter is on the results of case Pig City and case Lite City (7.2 and 7.3). After a description of the case, the results of the case studies are presented on the basis of condensed within-site displays for each case. These displays are based on information from the interviews, relevant documents and physical artefacts. Before we present the results from the case studies Pig City and Lite City, we describe the alterations in our set of variables as derived from the propositions defined in chapter 6 (7.1).

The focus of the second part of this chapter (7.4) is on the cross-case analysis of all cases in this study (being Medical Education, Social Sciences, Pig City and Lite City). In order to perform this cross-case analysis, the data from Medical Education and Social Sciences are re-assessed on the basis of the altered set of propositions and variables (see chapter 6 and paragraph 7.1). On the basis of this cross-case analysis, we draw conclusions on factors influencing the success of the innovative process and we develop a final model for the design of radical innovations in KISF's (chapter 8 and 9). This model will be tested in the second part of this research project.

7.1 PROPOSITIONS AND VARIABLES REVISITED

On the basis of the revised set of propositions as presented in 6.4 and the revised conceptual framework and its constructs, the following set of variables can be added to the original set:

Variable: **Idea generation phase** (Tushman and Rosenkopf, 1992; Vrakking and Cozijnsen, 1992; Rogers, 1995; von Krogh, 2000)

The phase in the innovation process in which the rudimentary concept underlying the innovation is developed and in which the following characteristics can be placed:

- = focusing on 'innovative issue' and/or broadening of 'innovative issue'
- = acquisition of knowledge
- = interpretation of knowledge into broad visions
- = translation of knowledge into rudimentary concepts.

Variable: **Crystallization phase** (Tushman and Rosenkopf, 1992; Vrakking and Cozijnsen, 1992; Rogers, 1995; Lindberg, 1998; von Krogh, 2000)

The phase in the innovation process in which the rudimentary visions and concepts are transformed into the core concept for the innovative process and in which the following characteristics can be placed:

- = translation of rudimentary views and concepts into a core concept
- = definition of a core concept for the innovative process
- = agreement upon the core concept by relevant stakeholders
- = communication of the core concept to relevant parties.

Variable: **Evolution phase** (Tushman and Rosenkopf, 1992; Vrakking and Cozijnsen, 1992; Rogers, 1995; von Krogh, 2000)

The phase in the innovation process in which the concept is developed into concrete products, services and/or activities and in which the following characteristics can be placed:

- = the development of products, services and/or activities for clients within the new frame of reference
- = the implementation of these products, services and/or activities in the organization
- = the fine-tuning of these products, services and/or activities by knowledge workers before or during its use for clients.

Variable: **Reified core concept** (Star and Griesemer, 1989; Fujimara, 1992; Brown and Eisenhardt, 1995; Wenger, 1998; Dougherty, 2000)

A core concept that forms the basis for the innovative process, and one that is recognized as the leading concept by all parties participating in the innovative process, and comprises the following characteristics:

- = provides a frame of reference for the innovative activities
- = is agreed upon by relevant parties as the leading concept for the innovative process
- = forms the mental model for the innovative activities
- = forms the basis for interpretation and communication on the contents of the innovation.

7.2 RESULTS CASE PIG CITY

7.2.1 Case description Pig City

The projects Pig City and Lite City are both developed by the architectural firm MVRDV; we therefore give a short introduction to this organization:

MVRDV

MVRDV designs not only the usual houses, apartments and office buildings but also visionary schemes. This vision stems from the innate Dutch desire to accumulate more usable land. Just as the Dutch reclaimed land from the sea for horizontal agricultural development, MVRDV reclaims space by building vertically.

Around fifty architects, designers and staff members of MVRDV are organized into teams. In each team, different fields and scales of MVRDV's projects are reflected, both in the (international) background of team members and in the variety of their work. MVRDV has permanent relationships with engineering firms to activate the exchange of knowledge. MVRDV invites different and at times unexpected disciplines to join forces with them, thereby mixing disciplines.

At an early stage of the design process, as many users and advisors as possible are involved, creating a high degree of support for the design and encouraging innovative solutions.

The office of MVRDV is very strong in organising its process of knowledge development and innovation. This is done by an informal structure and processes and fuzzy logic. In the office

there are no standardized approaches towards innovation processes. The design of innovation processes are strongly based on the project and situation at hand.

The office is developing growth strategies on knowledge mainly by the creation of an R&D-department. R&D-departments in chemistry are taken as an example.

Pig City

Pig City as an innovation stems from a 'family of innovations' centering on the themes of 'space and density' and 'space and value' and the integration between rural and urban space. As such it is enriched and will enrich other projects of the office. Pig City is to be considered as a prototype that is developed based both on theoretical concepts of the office and on assignments by clients.

Although Pig City is more the illustration of a concept than a real product, it now starts to lead to actual products based on its underlying concepts: vertical fishtanks are being built in Japan; the province of Brabant in the Netherlands looks for related solutions on pig farming; the Dutch Institute on Agriculture and Economics (LEI) started an economical feasibility study on Pig City, which may lead to the realisation of a 'stacked pig farm'.

Pig City is a prototype, with one of its functions an experimentation for further improvement of this line. The prototype is thus imperfect but still realized in a thorough and realistic way. The production of prototypes fits in with the development of MVRDV as an architectural firm that sells both products and ideas. The generation of ideas and development of prototypes has led to more and qualitatively higher levels of clients for MVRDV.

Pig City is considered a radical and frame-breaking innovation, because of its effects in terms of attention and public discussion, as well as its commercial aspects. It is also considered as radical, since it leads to further development of concepts for product development and thereby adds to the strategic position of MVRDV.

Causes for innovation

The organisation is autonomous in starting the project. Reasons for creation are strongly internally driven but are also sparked by client demands. The major innovator is driven by the urge to contribute to societal discussions about ecology and by a drive to change architecture into a profession that substantially contributes to societal issues.

In addition causes for the start of Pig City are:

- Recent animal diseases.
- Clash between urbanisation and farming.
- The existing preliminary ideas about pig farming developed by others.

The innovation

Pig City is a comprehensive solution to these issues. It envisions 40 farms stacked in 87-by-87-metre towers rising more than 500 metres high. Pigs are transported via elevators to a slaughterhouse on the ground floor, preventing disease from spreading. Pigs are organically fed with grain grown on the property around the towers, on organic garbage and high-protein Tilapia fish

- which in turn feed on the pigs' manure, achieving a closed feeding system. Rainwater is collected in basins through a reed field around the tower, and hay grows in a 7.5 metre diameter around the tower and hangs in rolls, like toilet paper, from the ceilings to supply the pigs' bedding. For additional pig pleasure, apple trees are planted in the towers. Air is filtered through water stored in rooftop tanks. The pigs' manure is processed into methane gas, which supplies electricity to both the tower and to 2,250 housing units nearby. The pigs waddle around on 640-square-metre balconies cantilevered from the building exterior, planted with oak trees complete with the prerequisite' truffles at their base. MVRDV calculated that 76 towers are needed to satisfy the current demand for pig products - 32 for the urban areas in the Netherlands and 44 clustered near harbours for export.

Innovation process

The innovation process is characterized by cyclical processes in the development of concepts and products. In this process prototypes are both end products embodying and illustrating underlying concepts as well as opportunities for learning and further development. In the developmental process prototypes play an important role in terms of both illustration and room for experimentation.

There are different themes of development in the office, which interact, influence and enrich each other. New products may spring from a combination of different themes.

The process of development is cyclical and iterative and in that sense a bit diffused, but the following main phases can be discerned:

Concept development

This phase is dominated by the development of the first ideas about application of three dimensional space to nature and agriculture. The founder and major innovator of the office plays a central role in this phase. During his career he has developed along with others the central concept of the office 'space and density' and 'space and value' and also ideas about the movement of agriculture between rural and urban spaces and nature and industry. The development of the concept has been influenced by the personal experiences and viewpoints of the innovator, the office concept, client assignments, and meetings with professionals in the field of architecture and landscape-architecture. Altogether this has led to the creation of the concept of stacked agriculture and the move of agriculture from nature to industry and from rural landscapes to urban settings.

The 'central group' of the innovator and external professionals functions as a situational community of practice. It does not meet on a regular basis. The group discusses several themes in a more or less explorative way (with the concept of stacking as a side effect of the major focus). Next to this most influential group, several other groups play a role. These consist of professionals in the same field and other fields. Their major contribution is the combination of new and unrelated viewpoints and the stimulation of each other's thoughts in the direction of original combinations.

There is in this phase a strong interaction between actual experiences with projects and prototypes and with new concepts.

Crystallization

In the crystallization phase the ideas about applying three-dimensional space to nature are discussed in different groups and environments, leading to initiatives and proposals from the office on 'stacked building designs' in different contexts. One of these is discussed in a meeting with a major art gallery. In this meeting Pig City is conceived and they decide to develop the product. Further interaction between the innovator and this external partner is directed both at further development of the ideas and at their feasibility in terms of financial conditions. The external partners play a major role in anchoring the project in the art gallery, thereby providing for future exhibitions. External stakeholders are found as investors.

Interaction in this phase is explorative and is directed mostly at the development of a crystallised concept.

Research and development of the prototype

This phase is dominated by data collection and research in order to build the prototype Pig City on the basis of the concepts from the first and second phase. A workforce within the office and external informants, play a major role in the realization of the prototype. There are several sources of input for this workforce:

- The concept of the office and the original ideas about Pig City.
- Outside data from different sources, used as a knowledge base for several aspects that need elaboration.
- Experiences from earlier projects and prototypes in the same line of development.

The major innovator takes decisions on the direction of the development of Pig City on the bases of the proposed suggestions by the workforce. In an iterative process among data research, discussions and design, the movie 'Pig City' as a prototype of Pig City is developed.

In this phase there is a central role for internal members of the work force and relevant outsiders, mostly on a bilateral basis. Because of reasons of efficiency and finance, there are no elaborate group discussions on the subject of Pig City. As one of the members of the workforce stated: "We organised our own internal discussions and community of practice on the base of the information we gathered".

In this phase there is some co-development with the LEI, providing both new and relevant information and strategic anchoring of the subject. Strategic anchoring is achieved by bringing the project to the attention of the right people. LEI functions as a strategically important (network) sponsor for the project.

Discussion and application

The prototype is shown in several settings to relevant groups and is discussed among the major innovator, investors in the prototype and external stakeholders. The prototype is used by the investors and MVRDV to spark discussions on and acceptance of the subject in society. After the launch of the movie, it is broadcasted by stations all over the world. This leads to major publications on the subject and to interviews with the innovator. Once Pig City is developed, it leads to several demands from clients. A financial feasibility study will be performed to see whether Pig City can be realized.

Results

Pig City has added value compared to ideas on pig stacking developed previously:

- Due to the method of presentation, the idea gains strongly in terms of acceptance by relevant groups and is brought to the attention of a broader public.
- The concept is extensively worked out, increasing the potential for actual realisation.
- Founding the concept in a theoretical, sociological and philosophical base, it defines agriculture as an urban and industrial process. This broadens and deepens the political discussion on the future of agriculture and on the use of space for it.

7.2.2 Within-Site analysis case Pig City

A. Success and character of the innovation

The innovation can be considered successful, because there was a positive score on 3 of the 5 proposed characteristics:

Case Pig City	Criteria	Description	Result
	<i>Possibility to implement</i>	The possibility to implement the innovation is being developed, small scale applications have been executed.	Positive
	<i>Duration of life</i>	Duration of life cannot be measured yet as it has not been implemented; however the issue and developed approach are back on the agenda.	Unknown
	<i>Realization of goals</i>	Goals have been realized as small scale applications are developed and the project is considered an important step forward in the political and public discussion of the subject.	Positive
	<i>Considered a success by relevant others</i>	The innovation is considered a success by relevant others. First, the innovation has achieved significant acclaim in the professional community. Second, the innovation has achieved a great deal of general media attention both on a national and an international level. Third, the innovation is generally considered as an important step in the discussion and acceptance of the subject.	Positive
	<i>Realized pay offs</i>	It has led to improvement of the strategical position, as the firm is more and more considered to be a firm of ideas rather than of designs alone.	Medium

Display 7.1- Pig City I: Degree of success

The innovation can be considered as a radical innovation, because there was a positive score on 3 of the 4 mentioned characteristics:

Case Pig City	Criteria	Description	Result
	<i>Basis for developments</i>	The innovation integrates different lines of conceptual thinking and therefore forms the basis for a new line in conceptual thinking.	Positive
	<i>New insights in the professional community</i>	The innovation forms the basis for a line of small-scale applications.	Medium
	<i>Generalization to the professional community</i>	The innovation forms a basis for national and international experiments on the underlying concept.	Positive
	<i>Status in the professional community</i>	The innovation is generalized to the wider community both within and outside the professional network.	Positive

Display 7.2- Pig City II: Character of the innovation

B. Phases during the innovation process

Phase	Activities case Pig City
Idea generation	<ul style="list-style-type: none"> ▪ Noticing developments and emerging problems ▪ Developing preliminary ideas about the subject ▪ Discussions in the external network concerning related subjects (not always directly aimed at the subject at stake but also at developing ideas on the subject as a side-effect of the discussions) ▪ Recognizing approaches and ideas that can fit into the innovative process ▪ Pre-project activities that were underlying the development of the project ('try-outs')
Crystallization	<ul style="list-style-type: none"> ▪ Reframing the subject into a new perspective (reframing a rural question into an urbane frame) ▪ Placing and clarifying the project and the ideas behind it in the leading concepts of the office ▪ Creating concepts as the framework for the innovation ▪ Combining underlying concepts into the basic ideas for the prototype
Evolution	<ul style="list-style-type: none"> ▪ Transforming the concept into detailed and worked-out plans ▪ Research and collection of knowledge and ideas that contribute to the innovation ▪ Integrating and transforming knowledge and ideas into the final product ▪ Introducing knowledge and information into the plan ▪ Communicating with the public about the project, starting and leading public discussions ▪ Combination of the project with projects in other concept lines (moving from the evolution phase into a new development and crystallization phase)

Display 7.3- Pig City III: Phase and activities

The three phases as defined were present and visible in the process. In Display 7.3 the activities that took place during the different phases are described. Analysis of the different phases and activities shows that:

- In the *idea generation phase* the focus was on the development of ideas and visions about the subject. There was active participation in external networks. This phase was not intentionally and solely focussed on developing the innovation. It was part of the total work process of the 'innovator' and dealt with a general building of views and ideas and with discussions with relevant outsiders in the context of other projects. In this sense there is no clear starting point for the idea generation phase. The development of the innovation in this phase seems to be characterized more by 'emergent' than by intended processes. However during the development process the focus changed from emergent innovative processes towards intended innovative processes as the goal and contents of the innovation became clearer. The external circle in this phase was not one clearly defined group of people but had the form of different external networks that are sometimes connected and sometimes not.
- The *crystallization phase* was in a number of aspects less recognizable than the other phases. There was, however, a phase where the choice was made to develop the concept 'Pig City'. This phase emanated from the ideas and visions that arose in the idea generation phase. The broad concept of Pig City was the basis, framework and touchstone for the activities during the evolution phase. The concept of Pig City was the collective concept for a number of underlying concepts that were combined in the realization of Pig City and formed the framework for both realization activities and for political discussions on the subject. In the innovation phase there was not one clearly defined group of people. The core party in the crystallization phase was the innovator. In this phase he was surrounded both by a selected group of external stakeholders and by internal project leaders in the office.
- The *evolution phase* focussed on the realization of the concept of Pig City into a final product. Although this final product was in the first instance a video, it seems that other final products can be discerned: the political and public discussion on the subject and the buildings that were developed on the basis of the concept of Pig City. In this sense the video and elaborated program of Pig City can be considered as both a final product and a prototype that is the basis for new developments and evolutionary processes, based on the original, more radical innovative process. In this further development, this project is combined with others, thus providing ground for more innovative processes. In the evolution phase two groups seem dominant. The first group is the internal circle (with one external member) that developed the final product. This internal circle had strong bilateral contacts in the external network. The second group is the external network that participated in public and political discussions. This group can be characterized as a somewhat loosely coupled network. The external member of the internal circle formed a strong linking pin between the innovator and the internal circle on the one hand and the external network on the other.

In general Pig City can be considered as both a radical innovation process in itself and at the same time, as a process that is part of a more comprehensive innovative process.

C. Actors

In terms of the variables regarding the different groups that play a role in the innovative process the following can be stated:

- *External circle:* there is no clear external circle in the sense of one tightly-grouped external network. There are different external networks that play a role at two moments in the innovative process. The first comes in the *idea generation phase*, where different external networks (that are loosely-coupled or not) play a role in bringing in or giving ground for the creation of new ideas. The second moment is in the *evolution phase*, where different networks (coupled or loosely coupled) play a role in participating in the political and public discussion on the final product and its underlying concepts. This external network plays a central role in opinion building and acceptance of the final product and its underlying concept.
- *Strategic circle:* it is hard to define an exact strategic circle. The strategic process underlying the innovative process, however, seems to have been in the hands of the innovator, a member of the external network who participated in the idea generation phase and who created opportunities for the publication of the final production and for stimulating the exposure of the final product, and a member of the external network who was also a member of the project team realizing the innovation and who played a central role in the creation of the network for the public and political discussion. Both external actors had a strong and influential role in the acceptance of the product by relevant others (outside the office).
- *Internal circle:* there was a clear internal circle consisting of members of the office (project leader and project member) and an external actor who was also a member of the project team.

Central linking pins in the process were the innovator, who was central in the external network, in the strategic circle and in the executive role in the office, and the external actor who had a role in the external circle in the evolution phase, but also in the strategic circle and the internal circle.

D. Core concept and learning model

In general the learning model and its existence in this case can be summarized as follows:

Case	Reified core concept	Reflection/ Conceptualization	Experience	Learning Style	Goal Orientation
Case Pig City	Clear	High to medium	Medium to high	Experimental/ boundary spanning	Personal knowledge building/ problem solving

Display 7.4- Pig City IV: Reified core concept and learning model

Phase	Reified core concept	Reflection/ Conceptualization	Experience	Learning style	Goal orientation
Idea generation <i>Description</i>	--	You have the shock and then a sort of brain-wave. The slipstream: talking about a subject and then thinking it can be transferred to another subject.	You use the projects for the side effects. We knew how to position the whole project.	We would like to experiment and see it work. You use the project to develop other innovations and techniques. I met a student who was working on it.	I am developing myself; that is a motivation. My main concern was to look at problems and come up with a solution.
<i>Result</i>	<i>Non-existent</i>	<i>High</i>	<i>Low to medium</i>	<i>Experimental Boundary spanning</i>	<i>Personal knowledge building Problem solving</i>
Crystallization <i>Description</i>	They are reframing the rural in the urban. It is a combination of agriculture and architecture.	We are connecting fields that were not connected before. My boss gave me the concept and we used this as a starting point of reference.	It is the interaction between the prototype and the concept that is interesting. There were all sorts of things in the air.	--	--
<i>Result</i>	<i>In creation</i>	<i>High to medium</i>	<i>Low to medium</i>	--	--
Evolution <i>Description</i>	It is one project in a clear conceptual line. The concept is the frame for the innovation. The concept is about space and density; space and value.	I told them we could make it more extreme. They already had the concept. We bring in new lines of information and if needed, change the circle of thinking.	You meet the professionals who are not good at combining but are good in their own field; that is a nice combination. We needed different kinds of experts.	The concept of the pig apartment already existed but we put it in a different frame. You learn from your mistakes and improve on them.	I am personally interested. We had an assignment to develop a solution for silos. My role is to work out a wide field and then a meeting and then see which we do.
<i>Result</i>	<i>Clear</i>	<i>Medium to low</i>	<i>High to medium</i>	<i>Boundary spanning Continuous improvement</i>	<i>Personal knowledge building Task oriented Problem solving</i>

Display 7.5- Pig City V: Phases in relation to core concept and learning model

There are differences in the existence of the core concept and the learning model used, according to the phase of the innovation and the role and position of the actor in the innovative process:

The idea generation phase is characterized by:

- *The non-existence of a reified core concept:* In this phase, on the basis of different developments and participation in different external networks the preliminary ideas and visions for the reified core concept are emerging and are in the second instance more intentionally developed into the basic vision and ideas for the core concept. The innovator, who is a member of both the internal circle (the office) and the external network, and a member from the external network play a central role in this phase.
- *High levels of reflection and conceptualization:* Based on a strong self-propelling way of reflective and conceptualization which is influenced by personal insights, brainwaves, newly created models and views within the professional field, research and the slipstream of discussions on other projects where ideas are combined into new views.
- *Low to medium levels in the use of experience:* Experience in projects that are not directly relevant but have a side connection to the issue at hand. Also further development of experiences that are spark-offs from other projects in the office.
- *An experimental and boundary spanning learning style:* The learning style was a mixture of experimental and boundary spanning. Ideas that were created in the slipstream of discussion on other projects, new views and brainwaves, and new concepts were combined and led to new insights and views. Experiments and experiences from other projects and frames of reference were used for the developmental process.
- *A personal knowledge building goal orientation:* Development of new ideas and views is the focus of the innovator and the office

The crystallization phase is characterized by:

- *The creation of a core concept:* On the basis of the views and ideas from the idea generation phase the concept of Pig City was created. The concept is both a concept in itself but is also a combination and overarching idea for a number of other concepts.
- *High to medium reflection and conceptualization:* The concept is formed by combining things that are normally not combined but is also based on existing themes and experiences in the offices and ideas and experiences from outsiders.
- *Medium experience:* The concept is partly based on experiences in other projects and experiences from others and lead in combination to the final concept and underlying concepts.
- *No clear learning style:* As this phase is not clearly defined, it is not possible to identify a clear learning style.
- *No clear goal orientation:* As this phase is not clearly defined, it is not possible to identify a clear goal orientation.

The evolution phase is characterized by:

- *A clear reified core concept:* There is a clear concept that is agreed upon by the relevant parties in this phase (although part of the political and public discussion is aimed towards reification of the core concept and especially towards the underlying concepts). The underlying concepts are clear and agreed upon.
- *Medium to low levels of reflection and conceptualization:* The focus was on bringing in and applying new knowledge and information within the context of the concept. Some reflection and conceptualization took place leading to new insights and creating new combinations of domains of knowledge.
- *High to medium experience:* The focus was on applying experiences from other projects and outsiders to the context of the concept.
- *Boundary spanning/continuous improvement learning style:* The focus was on bringing in insights and experiences from other projects and organizations. At the same time the focus was on continuous improvement of the concept and the final product.
- *Various goal orientations:* In the context of the project the focus was on problem solving and task orientation, but all participants in this phase were also motivated by personal knowledge building on the subject.

E. Information processing

In general the progress of the information processing activities can be summarized as follows:

Case	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Case Pig City	High	Medium	Medium	High

Display 7.6- Pig City VI: Information processing

Phase	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Idea generation <i>Description</i>	We always search for data and concepts. I brought in the information about stakeholders.	We had the discussion about the Floriade and there the idea of stacking was created.	--	The slipstream, you use information to develop new ideas and concepts. You use a prototype to experiment to develop innovations and new techniques.
<i>Result</i>	<i>High</i>	<i>High</i>	<i>Low to medium</i>	<i>High (conceptual)</i>
Crystallization <i>Description</i>	There were some developments in the environment, I brought in the whole general public political discussion on that subject.	I met two people who do data-processing, and I realized we could use information, statistics and presentation.	We are connecting fields that were not connected before	We used the solution of the fish in an other context.
<i>Result</i>	<i>Medium</i>	<i>High</i>	<i>Medium</i>	<i>Medium</i>
Evolution <i>Description</i>	We have a lot of contacts. There were other developments published at the moment.	With every step you get more questions and more questions with quality.	--	We take essential discoveries of research and apply them to smaller ones. What was nice was that in the end there was a product.
<i>Result</i>	<i>High</i>	<i>Medium</i>	<i>Medium - high</i>	<i>High</i>

Display 7.7- Pig City VII: Phases in relation information processing

There are differences in the information processing activities according to the phase of the project and the role and position of the actors in these phases:

The idea generation phase is characterized by:

- *High knowledge acquisition*, as a lot of knowledge and insights were obtained from the external network.
- *High knowledge interpretation*, as the focus was on the interpretation of knowledge within the context of emerging views and ideas, since a lot of 'slipstream knowledge' was used, it seems the focus was on creative interpretation rather than on acquisition of new knowledge.
- *Low knowledge distribution*, for in this phase the focus was on interpretation and development of new concepts rather than on the distribution of this knowledge.

- *High application* with a focus on application of knowledge in terms of the development of new concepts rather than on their direct application.

The crystallization phase is characterized by:

- *Medium knowledge acquisition*, as the focus is on the development of new concepts rather than on the acquisition of new knowledge; but at the same time the development of the concepts is a process that is in continuous interaction with new knowledge that is available.
- *High knowledge interpretation*, as the focus is on the distillation of a new concept out of emergent views and ideas and the fine-tuning of that concept on the basis of new knowledge.
- *Medium knowledge distribution*, as the distribution of the knowledge about the primary concept and underlying concepts to the internal circle takes place.
- *Medium to low knowledge application*, as the focus is on interpretation and distribution.

The evolution phase is characterized by:

- *High knowledge acquisition*, as there is a strong focus on research and importation of existing knowledge and experience in the context of the concept.
- *Medium knowledge interpretation*, as the focus is more on application than on a more abstract interpretation (however, there is still interpretation, for different views are evaluated and weighed according to their usefulness).
- *Medium knowledge distribution*, as the distribution is limited to the internal circle in the process of the realization of the final product.
- *High knowledge distribution* in the process of organizing public and political discussions on the subject.
- *High knowledge application* in the use of experiences from outsiders and other projects within the context of the realization of the final product.

F. Political processes

In general the political processes during the innovative process can be summarized as follows:

	Between groups			Within groups		
Case	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Case Pig City	Open	Medium	Medium	Medium-closed	Open-medium	Medium-closed

Display 7.8- Pig City VIII: Political processes

	Between groups			Within groups		
Phase	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Idea generation <i>Description</i>	I opened up the discussion by framing it in the new concept. Because we were involved others in the network could be involved.	Forming parties with alliances with other parties is essential for the incubation of innovations.	It was a funny type of group. That certainly helped me in forming my ideas.	The group processes in the firm are very important. In bringing up ideas you are inspiring people.	In the office a lot of amazing suggestions are made by employees. New ideas and research will evolve and improve concepts	In that project we worked with a number of people who were very open to innovation, who want to take risks.
<i>Result</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>
Crystallization <i>Description</i>	--	I was a good entrance to knowledge and existing networks.	We got very negative comments, but I opened up the discussion by framing it by the new concept.	You need a little club that just realizes the ideas. The cooperation was very informal but based on mutual respect.	They stuck to their stream of ideas, but within that stream information exchange was rather open.	We come with solutions and he tells us whether it is good or not good, and then we take it to the next step.
<i>Result</i>	--	<i>Open</i>	<i>Medium</i>	<i>Open to closed</i>	<i>Medium</i>	<i>Medium to closed</i>
Evolution <i>Description</i>	Some outsiders came in as experts.	As a centre of knowledge we were not the preferable partner, but in terms of provision of networks of stakeholders we were.	We always put in more than we think we can get, so that when it gets reduced it is still an interesting product.	In the office everyone really does research and comes up with new products. My influence is not there, it is natural, but sometimes difficult.	You broaden it and from there you close it more. The vision is the structure of the project.	You have twenty examples and the boss chooses.
<i>Result</i>	<i>Medium</i> <i>Closed to open</i>	<i>Medium</i> <i>Closed to medium</i>	<i>Medium-closed</i> <i>Closed to medium</i>	<i>Medium-closed</i>	<i>Medium</i>	<i>Medium-closed</i>

Display 7.9- Pig City IX: Phases in relation to political processes

There are differences in the political process depending on the phase of the innovative process and the role and position of the different actors. One general finding is that there are no clearly defined groups or circles that play a role in the different phases. In this sense the process is more diffuse.

The political process in the different phases can be described as follows:

The idea generation phase is characterized by:

- *An open relation between groups* with very permeable borders between the different networks and frequent exchange with relevant outsiders (belonging to different groups). Relations are clearly characterized by added value of participants; communication is open and inquisitive, not always geared to the focus of the innovative process and therefore offering opportunities for creativity.
- *An open relation within groups*, where relations are based on the development of knowledge, with open selection of members on the basis of added value, a goal orientation aimed towards the development of new knowledge, and an investigative and entrepreneurial attitude.

The crystallization phase is characterized by:

- *Open to medium relations between groups* with no clear view on the information exchange between groups, open foundations for relations, while there is still a search for valuable knowledge to add to the improvement of the core concept, and a medium-open-to-closed character of communication where dialogue is slowly replaced by the assumptions based on the core concept.
- *Medium to closed relations within groups* with a focus on the strategic and the internal circle, where relations are closing in on the compliance to the core concept and its underlying norms and values and the composition of the groups is based on the management of political relations, with a goal orientation aimed both towards building but also optimizing the concept and attitudes that are slowly closing down as they start an investigation into the concept, but later become more focussed on the chosen concept and on optimizing this concept.

The evolution phase is characterized by:

- *Medium open to closed relationships among groups* where it concerns the realization of the final product. Information exchange is medium, for there are no permeable borders; but within the framework of the concept there is an intensive exchange of information with outside groups. Foundations for relations are influenced both by added value and by the existing concept. The character of communication is open (putting black to white) but takes place within the framework of the concept.
- *Closed to open relations between groups* where it concerns the political and public discussion. Boundaries between different groups are opened up; relations are transformed from being based on existing coalitions towards broader discussions and relations on the basis of added value in the discussion of the subject (but in the context of the concept). The character of the communication becomes based more on dialogue but is at the same time based on the core concept.

- *Medium to closed relationships within the group* where it concerns the realization of the final product. Medium-to-closed relationships as binding and selection are based on compliance with the core concept. Medium goal orientation as it is aimed towards optimizing the concept, but at the same time is used for new ideas for other projects in the office and medium to closed attitudes as they are geared towards optimizing the concept; nevertheless there is still some room for investigation and new ideas.

G. Organizational conditions

On the basis of the available information it can be concluded that in the organization there was:

Case	Room for reflection and metacognition	Stimulation of participation in external knowledge networks
Case Pig City	High to medium	High

Display 7.10- Pig City X: Organizational conditions

- *High to medium room for reflection and meta-cognitive activity:* although the director chooses the concepts and selects results from research that will be used, there is room to redefine the vision or the projects and projects start with a broad check on different visions. In general there is room for members of the office to bring in new ideas. Employees are deliberately selected on wide cultural backgrounds.
- *High stimulation of participation in knowledge networks:* teams are stimulated to look for outsiders to participate in the projects. There is a separate P.R.-department that has a role in this. Within the office the exchange of people in projects is strongly stimulated.

7.3 RESULTS CASE LITE CITY

7.3.1 Case description Lite City

The concept of Lite City is part of the underlying concept of change-ability and flexibility of cities. All parts of the city are after a number of years subject to renewal. The concept of Lite City is that the period for renewal is drastically decreased, from an average of 30-50 years to 10 years, by introducing infrastructure that can be 'rolled up'. Due to this, 'Lite City' is totally replaceable after a short writing-off period of the investment. Housing can be demolished and replaced by either another function or new houses built according to new standards. The biggest potential for this idea lies in the suburbs of a city (as both investments are too high in the city centre and density of building is too high for 'lite infrastructure'). Lite City is contrary to the prevailing paradigm of VINEX-locations of suburban building of houses in high density and for long periods of investments (write-offs in 30 years).

At the same time that Lite City is developed by MVRDV, related concepts are developed by others. Clouds of related concepts are developed rather than just one concept. MVRDV is one of the pioneers in this movement.

The concept of Lite City is introduced in a number of projects and in cooperation with several outside partners. The concept is introduced and discussed in Barendrecht, but the initial vision is not accepted by the city-council. The concept is also introduced in a plan for a landscape design for 'the Eendragtspolder'. Part of this polder is already annexed by Rotterdam. There is a need for a clear vision for the landscape that gives the polder sufficient strength to stay on its own, instead of becoming another extension of Rotterdam. The discussion on this issue is very much a political one among local politicians, national government and other external stakeholders. As part of the vision for the landscape a couple of concepts are developed and cooperation is initiated with a large institution and several other external partners to co-develop plans. Together several models are developed. Lite City forms part of one of the models.

Causes for innovation

The reasons for the start of Lite City are:

- *Client requests:* A request for coming up with an alternative model of a vinex-district in Barendrecht, instead of a classical design. The high density of houses in the district is due to cover the investments of the facilities that are part of a 'traditional design' for suburban building. Researching options for reduction in the expenses leads to the concept of Lite City.
- *Vision and internal drive of the innovator:* A reaction on the Bijlmer and Detroit, which are both very dense, and the urge to create an antipole to this.
- *Societal trend:* On a world scale a trend emerges for cities to change in line with the state of the economy and politics. These two elements give shape to a new form of rural building.
- *Societal trend:* There is a larger demand for differentiation, Lite City is part of this differentiation. People want to mix, and do not only want to live in big districts; this can only be accomplished by an increased flexibility of districts.

Lite city is an experiment with a concrete motive. It has not been realized as yet, but some recent developments show in the direction of renewed (or new) interest for change-ability. About six years after the original idea of Lite City it seems that time may now be ripe.

Innovation process

Lite City has not yet been realized; the last phase of evolution is therefore missing in this process. Till now it has not grown out of the stages of idea generation and part of the crystallization phase. Due to conflicting interests it never came to an implementation of the ideas.

Idea generation phase

A first concept is introduced in Barendrecht. This is based on a demand to develop a plan for a small natural area (a scrap of land that is too small to be used; MVRDV develops the plan to enlarge the piece of land by building houses with light infrastructure that can easily be removed; the plan reduces the costs of suburban building so that more surface for building can be used). The responsible councillor is positive, but is not able to get the concept accepted by the rest of the city council. This is followed by a request from another region to make a landscape plan for a natural area to prevent it from being claimed for dense suburban building by a neighbouring

city. The plans for Lite City form an antidote to the reigning paradigm of high density Vinex-building.

A project team is formed by MVRDV and several external partners, to include all the expertise needed for the project and realize cross-fertilization on the issue of suburban and lite building.

This project is a design assignment. This creates a tension for coming up with new ideas: 'on the one hand you want to think as extremely as possible to come up with really new ideas, on the other hand you have to keep in mind the practicability of these ideas as well'. Another tension is created by the fact that in the process at a certain moment the ideas created by different members of the project team have to be converted into one collective idea, while the different parties are not at all aligned in terms of their ideas. This creates divergent views and makes it difficult to come up with one clear idea. In the final plan a number of concepts are combined.

Crystallization phase

In the crystallization phase political support and agreement about the direction of the concept is sought. On both aspects success is not realized. Obtaining the political support is difficult due to resistance from a number of major decision makers and opinion leaders who are included in the process. The policy from the government is very rigid and restrictive, unsupportive of agreement on the project. Attempts are made to convince the opinion leaders to take a longer time horizon than the present policies and use the concept for future developments. The views on the Eendragstspolder project are taken home by a number of people for possible future plans, but have not yet lead to further development of the concept.

During the process the different parties that develop Lite City have different (but not conflicting) views on its objectives and give different interpretations to the concept. Views within the group of developers diverge on the subject. This does not contribute to a successful propagation of the concept.

After discussion of the plans with the external stakeholders all development of plans for the Eendragstspolder stopped. The concept of Lite City was not pursued for further development. The result of the crystallisation phase is unsuccessful.

Results

Although the strategic innovation of Lite City is not realized, there are a number of results:

- The concept of Lite City has not been realized as yet.
- There is not one clear universally agreed concept of what Lite City is. There are, however, a number of more diffuse concepts developed that are related to or stem from the original concept.
- One of the partners in Lite City has developed the concept further (and in another direction) in order to build an 'autarkan' house.
- The concept of change-ability that stems from Lite City is now slowly developed further (but not yet realized).

- The concept is transformed into a broader perspective in regional and city planning (RheinRuhrCity) where ‘Liteness and density’ of certain areas forms part of options for regional planning.
- The concept of Lite City is paralleled with other movements where ideas on building are more loose and flexible. These concepts and Lite City have influenced the abandoning of the idea of vinex-districts.
- In the framework of Lite City there are requests for flexible house-building, which lead to neutral building.

On the basis of experiences with Lite City, the innovators mention that it is hard to apply really innovative concepts in isolation on a local scale, especially when they are contrary to dominant designs that are strongly institutionalized and still in full swing.

7.3.2 Within-Site analysis case Lite City

A. Success and character of the innovation

The innovation cannot be considered as successful, because there was a positive result on less than 3 out of the 5 criteria. In fact there was only a medium positive result on one of the criteria:

Case	Criteria	Description	Result
Case Lite City	<i>Possibility to implement</i>	It is worked out in different degrees, but mostly in rough sketches. As a residential concept it has not yet succeeded; as a function mix it is slowly being accepted.	Medium positive
	<i>Duration of life</i>	We aren't using it as yet.	Negative
	<i>Realization of goals</i>	A good project, a step further in the spiral of development, but not as yet in its final appearance.	Negative
	<i>Considered a success by relevant others</i>	For me it was not a failure, but as an accepted concept it did not succeed.	Negative
	<i>Realized pay offs</i>	There were no reactions to it. No projects have been realized so far.	Negative

Display 7.11- Lite City I: Degree of succes

The innovation cannot be considered as a radical innovation, since there was a positive result on fewer than 3 out of the 4 criteria. In fact there was only a medium positive result on two of the criteria:

Case	Criteria	Description	Result
Case Lite City	<i>Basis for developments</i>	The underlying concept of changeability is applied in flexible building. It is not Lite City, but is more Lite than the existing way of building.	Medium positive
	<i>New insights in the professional community</i>	Lite City as a concept for building has not succeeded, but Lite City as a concept in function mixing is slowly finding response.	Medium positive
	<i>Generalization to the professional community</i>	The whole idea about Vinex locations is changing, but there is not one name attached to this.	Negative
	<i>Status in the professional community</i>	Our name is not related to this concept.	Negative

Display 7.12- Lite City II: Character of the innovation

B. Phases during the innovation process

Phase	Activities case # 4
Idea generation	<ul style="list-style-type: none"> ▪ Noticing emerging problems ▪ Questioning the dominant views on residential building (within the company and in the external network of professionals and decision makers) ▪ Developing the idea of Lite City as a new approach towards residential building ▪ Identifying other professionals that have related approaches to the idea ▪ Developing the idea of Lite City into a more substantial rudimentary concept in the context of several proposals and projects ▪ Working together with other professionals in different projects and developing different approaches and applications of the concept Lite City
Crystallization	<ul style="list-style-type: none"> ▪ Reframing the discussion of suburban building and living in the context of Lite City (and in a later stage reframing the discussion on urban building and living in the context of changeability and Lite City) ▪ Developing different proposals for suburban building and living according to the concept of Lite City ▪ Discussing the concept, its application and its consequences with clients and relevant partners in the field of decision makers and clients
Evolution	<ul style="list-style-type: none"> ▪ No activities

Display 7.13- Lite City III: Phase and activities

The phases are quite hard to discern in the processes taking place. There were different projects on Lite City, and each had their own participants and actors. As a consequence there were several idea generation and crystallization phases that were not successive, but somewhat scattered in time. The evolution phase was never reached, as the crystallization phase never finished with a positive result forming a base for the realization of the concept. In display 7.13, however, the

activities that took place during the different phases are described. Analysis of the different phases and activities demonstrate that:

- In the *idea generation phase* the focus was on both a critical discussion of the prevailing paradigm on suburban living and building (the so-called Vinex locations) and the actual demands in the market. The paradigm discussion was held at several different constellations and moments in the relevant external network (consisting of other professionals, decision makers and clients). In the professional field several answers to the prevailing paradigm were developed, thereby creating a wider innovative range of ideas. One of these was the idea of Lite City by MVRDV. As such the idea was part of a 'group of new concepts', developed in reaction to a dominant, but criticized paradigm. In line with this critical discussion, three different requests for projects in the field of suburban living and building reached MVRDV. Within the context of these requests relevant partners were sought and found who had either (or both) a congruent view on the issue and relevant expertise. In the different projects different models based on the underlying idea of Lite City were generated. In the different projects Lite City was developed in different ways, sometimes being more 'pure', sometimes less pure and part of a larger proposal. The concept of Lite City was thus a diffuse concept that was both a more conceptual (in reaction towards a dominant paradigm) and an empirical development (as an answer towards actual demands in the market). In this sense the idea generation phase had characteristics of both a pure idea generation phase and characteristics of an evolution phase. Besides the projects there was no active promotion of the concept in the external (professional) field. The external circle in this phase was not one clearly defined group of people, but had the form of different external networks that were sometimes connected and sometimes not.
- The *crystallization phase* was characterized by the development of the underlying concept into different proposals on suburban living and building. This was done by reframing the discussion on suburban living and building in the context of the idea of Lite City. Although the concept was clear to the innovator, it appears from the documents and interviews that others had different views and ideas of what the concept was or meant. Consequently there was not one uniform and clear concept or prototype. The different proposals formed the framework for both political discussions on the subject and discussions on the willingness and possibility of realizing the innovation. These discussions did not have positive results; the concept was not accepted as a new or alternative paradigm for suburban building and living and none of the proposals was accepted for realization. This was (partly) due to the prevailing socio-political processes in which proponents of Lite City did not have enough strategic position and power to influence and overrule its opponents. Opponents were still thinking and working in the context of the prevailing paradigm. In general the opponents were the dominant decision-makers on the subject. In the crystallization phase there were different relevant groups of people. These consisted of professionals from outside working together with the innovator to develop the projects, clients for the projects, and decision makers at different levels. In some projects clients came from different external groups.
- There was no clear *evolution phase*, but, as mentioned, some activities in the idea generation phase had the characteristics of a realization process. This concerns the development of proposals for clients in the context of actual projects. These proposals, although rather tangible, were at the same time part of the process of development of the concept. As

such there was interaction between idea generation for the concept and realization and evolution of related products. Implementation and fine-tuning of these products never took place, as the concept of Lite City was not accepted for materialization.

In general Lite City can be considered as an innovation process that has resulted in different forms of the concept. It is thus more a general underlying idea (about suburban living and building) than a clear concept or prototype in itself. The underlying idea is part of a family of ideas under the name of changeability. Other strands of this family of ideas are now being developed and (possibly) applied in the context of urban building and living.

C. Actors

In terms of the variables regarding the different groups that play a role in the innovative process, the following can be stated:

- *External circle:* there were two external circles that played a role in the innovative process. The first circle, consisting of leading professionals from other firms, policy makers on the subject and decision makers, did not function as one tightly coupled external network. In essence they formed different external networks that played a role in the *idea generation phase*. The major role was in the political and public discussion of the prevailing paradigm, in opinion building and in the creation of alternative paradigms, including a range of more tangible ideas in line with the alternative paradigms.
The second external circle was a circle of closer colleagues, who in the idea generation phase helped in creating the idea of Lite City. In the *crystallization phase* this group had the character of an internal circle that was actually working together in shaping the idea into more tangible proposals.
- *Strategic circle:* there were different strategic circles that were related to the different projects executed. These circles consisted mostly of policymakers and decision-makers related to the subject. These policy- and decision-makers belonged to different groups and levels: officials from local, regional and national levels, as well as from government-related organizations and NGO's. There was a strong differentiation in these groups in terms of power and in terms of vision on the subject. In general the officials at the regional and national level were proponents of the prevailing paradigm and opponents of the new paradigm. These officials had the most dominant role and position in decision making processes. The innovator and some members of the closed external circle were actors in the strategic circle. As actors they had a peripheral role without much socio-political influence.
- *Internal circle:* the internal circle was partly formed out of an external circle, in which idea builders were transformed into a circle consisting of external colleagues and members of the office, who worked together as different project teams in the process of developing proposals in the context of different projects.

A central linking pin in the process was the innovator, who had a role in the external network, a peripheral role in the strategic circles, and a central role in the internal network.

D. Core concept and learning model

In general the existence and the learning model in this case can be summarized as follows:

Case Lite City	Reified core concept	Reflection/ Conceptualization	Experience	Learning Style	Goal Orientation
Result	Diffuse and differentiated	Medium	Medium	Experiential - non-experiential Acquisition Boundary spanning	Problem Solving

Display 7.14- Lite City IV: Reified core concept and learning model

Phase	Reified core concept	Reflection/ Conceptualization	Experience	Learning style	Goal orientation
Idea generation <i>Description</i>	It is more a clustering of ideas in one line than a concept.	You redistribute the urban and suburban area on the basis of new insights. The inducement was an assignment to develop an alternative model for a Vinex-location. They had their variant and I had mine, and these two streams came together.	The idea was lingering in the air Others came up with related ideas as well. Some things that were done, one should get rid of We used several ideas and theories and applied them where relevant.	We are combining and mixing different circles. I am passionate about not being anxious about change, but embracing it. They always work with people around them who have the knowledge they can use. The idea with the car, we used it from another project.	In looking for reductions we developed Lite City. We developed some new concepts and models to approach the issue. It gave us a fertile soil to develop new views on town planning.
<i>Result</i>	<i>Rudimentary ideas</i>	<i>High to medium</i>	<i>Medium</i>	<i>Experiential/ acquisition/ boundary spanning</i>	<i>Problem solving Personal knowledge building</i>
Crystallization <i>Description</i>	The concept was not solid and clear enough to withstand the prevailing conflicts. It was part of the concepts that were underlying the models we developed.	They developed the concepts and we brought in technical knowledge. It was too different from the current conceptual images here.	The pressure is growing and then you stick to the traditional division between red and green. We combined characteristics and problems and then we developed new approaches.	It had to comply with existing requirements. You have to stick to the traditional strategy.	We were confronted with the norms on density and we wanted to have a discussion about that and ecology. It was just a very clear assignment with a clear budget
<i>Result</i>	<i>Diffused and differentiated</i>	<i>Medium to low</i>	<i>High to medium</i>	<i>Non-experiential</i>	<i>Problem solving Task oriented</i>

Display 7.15- Lite City V: Phases in relation to core concept and learning model

There are differences in the existence of the core concept and the learning model used, in relation to the phase of the innovation and the role and position of the actor in the innovative process:

The idea generation phase is characterized by:

- *Reified core-concept: The creation of a rudimentary idea:* In this phase, on the basis of discussions in the field of professionals and relevant stakeholders on the prevailing paradigm, a rudimentary vision for a new alternative for this paradigm was developed. In cooperation with professionals with similar ideas on the subject several images of the alternative vision were developed. Central to this phase were the innovator as a core member of the internal/external network of co-operators and the external network of relevant stakeholders (a wider circle of professionals and policy- and decision-makers).
- *High to medium levels of reflection and conceptualization:* The rudimentary concept developed on the basis of discussions in the external network, the discussions with co-operating professionals and actual demands from clients. The development was a combination of reflective and conceptualization, a reaction to existing paradigms, and a solution towards actual practical situations.
- *Medium levels in the use of experience:* Use of experience was medium. Lite City was an attempt towards a paradigm shift, but this paradigm shift was in line with some emerging developments in the professional community. At the same time Lite City was developed on the basis of actual projects using insights and knowledge that were developed in other projects (this knowledge was also acquired by co-operating with other firms).
- *An experimental, acquisition and boundary spanning learning style:* The learning style was a mixture between experimental, acquisition and boundary spanning. Ideas springing from the discussion of the prevailing paradigm and emerging views within the professional field and new ideas were combined and led to new views. Experiments and experiences from other projects were used for the developmental process. Some of this knowledge was acquired by co-operating with other firms.
- *A problem solving and personal knowledge-building goal orientation:* There was a focus on both solving of actual problems and the urge to develop a new view on town planning.

The crystallization phase is characterized by:

- *The creation of a diffused and differentiated concept:* In several projects (parts of) the cluster of ideas underlying Lite City were developed into several more tangible concepts. The concepts were not clear as a single and strong concept to clients and decision-makers (the strategic circle in the crystallization phase). The concept was therefore not accepted as an alternative paradigm by relevant others.
- *Medium to low reflection and conceptualization:* The reflection and conceptualization that led to Lite City was not adopted by the relevant strategic circles in the crystallization phase. There was no exchange between different frames of reference or between practical and more abstract views in the strategic circle. The inner circle of co-operating professionals had a medium level of interaction between practical knowledge and more abstract views.

- *High to medium experience:* The strategic circle was high in experience; this however, withheld them from adopting a new paradigm. There was no successful interaction between the existing views and frames of reference and the new concept. For the inner circle the concept and application of Lite City was partly based on experiences in other projects and experiences from others.
- *Non experiential and boundary spanning learning style:* The strategic circle had a learning style that falls outside the categories used in this study but which is best described as the opposite of the experiential learning style. The inner circle in this phase is not clearly defined. It is not possible to identify a clear learning style.
- *Problem solving and task-orientated goal orientation:* The strategic circle was strongly focussed on the solution of existing problems. For the inner circle the learning style was mostly boundary spanning, using insights from other projects and other professionals and organizations in further developing the concept into applications for the projects.

E. Information processing

In general the progress of the information processing activities can be summarized as follows:

Case	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Case Lite City	Medium	Medium to low	Medium to low	Medium to low

Display 7.16-VI: Information processing

Phase	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Development <i>Description</i>	He came with his idea at the same time, but I had a different view. It developed from the situation and ideas I had. We met and I had knowledge that was more applicable.	We interpreted the concept in the context of flexible and neutral building. It needs translation otherwise it would not be accepted. I was an intermediate between designing and doing.	We brought it into several projects. I was an intermediate I keep my own ideas and company apart because we are competitors.	We translated the idea into several projects and applied it in different ways. There are no projects yet accepted. We brought in theories and models where relevant.
<i>Result</i>	<i>High to medium</i>	<i>High to medium</i>	<i>High to medium</i>	<i>High to medium</i>
Crystallization <i>Description</i>	We brought in technical knowledge and smart systems. The ideas were presented here. They liked it but they did not accept it .	In some sessions we developed our thinking further, but there were no people who really developed and distributed it. There were fundamentally different visions that could not be reconciled.	We had a lot of papers and presentations. I don't know if they shared the concept among themselves but they shared it with us. We talked in some sessions about the underlying ideas. The mayor was dominant and no one could get a foothold.	We did not apply it, but we would have liked to bring it into the discussion. Bringing in innovations and aligning different parties was not possible.
<i>Result</i>	<i>Medium to low</i>	<i>Low</i>	<i>Medium to high</i>	<i>Low</i>

Display 7.17- Lite City VII: Phases in relation information processing

There are differences in the information processing activities according to the phase of the project and the role and position of the actors in these phases:

The idea generation phase is characterized by:

- *High to medium knowledge acquisition* with medium levels of knowledge acquisition in a broader professional network at a conceptual level, but higher levels of knowledge acquisition in a more narrow external network regarding more practical knowledge needed for the realisation of Lite City.
- *High to medium knowledge interpretation* with less focus on the interpretation of knowledge within the context of emerging views and ideas than on knowledge interpretation concerning the application of the concept and translation in the context of projects. In a later stage there was more focus on the conceptual interpretation of Lite City within the context of changeability.
- *High to low knowledge distribution* where distribution was high in terms of bringing in knowledge in the context of actual projects, but low in terms of interaction between different conceptual frameworks.
- *High to medium application* with a focus on the application of knowledge in the projects, but with low actual application by clients.

The crystallization phase is characterized by:

- *Medium to low knowledge acquisition* as a lot of new knowledge was brought in to the projects, where knowledge from different sources was combined. The knowledge brought in was not accepted by the strategic circle.
- *Low knowledge interpretation* as there was no actual interaction between the knowledge brought in and the prevailing paradigm and conceptual framework of the majority of the strategic circle.
- *High to medium knowledge distribution* where a lot of knowledge from different sources was brought into the projects and was distributed in the group of external stakeholders in the context of the projects.
- *Low knowledge application* as the dominant parties in the group of external stakeholders did not accept the new concepts and thus did not apply them.

F. Political processes

In general the political processes during the innovative process can be summarized as follows:

	Between groups			Within groups		
Case	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Lite City	Medium	Closed	Closed	Medium	Medium	Medium

Display 7.18- Lite City VIII: Political processes

	Between groups			Within groups		
Phase	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Development <i>Description</i>	It has reached the government but has found no foothold. It was repudiated, but was picked up for an exhibition. They picked it up and put it in their plans.	The secretary of state saw the criticism and was brave enough to propose to change the product, but they blamed him for being much too party minded.	I told him it could be done in a more modern way. He was working with people with old-fashioned ideas.	They always look for people and work with people with relevant knowledge. I told him he didn't work with people with the right knowledge; so we started to work together.	We worked on ideas about which we normally say they are not possible. We did not aim at development of knowledge, we aimed at realisation.	No idea is too extreme; you can always bring them in. The cooperation was also competition, we presented our ideas under our banner.
<i>Result</i>	<i>Open to medium</i>	<i>Medium</i>	<i>Medium</i>	<i>Open</i>	<i>Medium to open</i>	<i>Medium to open</i>
Crystallization <i>Description</i>	There were a lot of changes in the opinions that were brought in. The discussion was a meeting with several participants. The ideas were presented there. They never came together as a group and shared knowledge.	The time was not right. The positions and assumptions were clear. They considered it as the toy of some enlightened thinkers.	Some people are really a sort of Yugoslaves, very strong in suppressing the others. That man had his own agenda. He did not want anything there.	There were not enough people to propagate the new ideas; it was too late to bring them into the discussion. Their visions were too different they could not be reconciled.	We had some interesting sessions in which we developed our thinking. They all had different interests; that was very clear.	We wanted to put the discussion into a new context. There wasn't enough team-building around the concept, either within the group as outside it. We didn't identify ourselves with the ideas that were brought in.
<i>Result</i>	<i>Medium to closed</i>	<i>Closed</i>	<i>Closed</i>	<i>Medium to closed</i>	<i>Medium to closed</i>	<i>Medium to closed</i>

Display 7.19- Lite City IX: Phases in relation to political processes

There are differences in the political process depending on the phase of the innovative process and the role and position of the different actors. One general finding is that there were several relevant groups that played a role in the different phases. In this sense the process was rather diffuse.

The political process in the different phases can be described as follows:

The idea generation phase is characterized by:

- A *medium open relation between groups* with permeable borders in terms of information exchange between the different networks, but with relations and opinion-building processes attempted towards opening up of the prevailing paradigm, but influenced by existing coalitions. Relations are influenced by both creative and knowledge-building processes and by existing assumptions in the different coalitions.

- *Open to medium open relations within groups* with open relations among the members of the more closed external circle, with a goal orientation that is aimed at the development of the new concept but also at finding solutions for existing situations. The attitudes are both investigative and (light) defensive, as there is some competitive protection of ideas and concepts.

The crystallization phase is characterized by:

- *Closed relations between groups* with in some cases information exchange between groups, but in other cases a low information exchange between different groups. Foundations for relations are strongly influenced by existing coalitions, with the dominant coalition leaving no room for new ideas from other groups. Communication is strongly influenced by the prevailing paradigm, whereby gatekeepers of this paradigm have an oppressive attitude towards the actors that bring in new ideas that are outside this paradigm.
- *Medium to closed relations within groups* with a focus on members of the strategic circle that are in the dominant power position and a refutive attitude towards the new ideas that are brought in. Some discussions within strategic circles had a more open character and discussed the new concepts freely, but in general the dominant group in the circle wanted to preserve the existing visions on suburban living and building. At the start there was in general an investigative process, but this became more defensive during the process, thereby refuting the new ideas.

G. Organizational conditions

In this case study little information was found or given relating to organizational conditions. Only two participants were able to give information on this issue. This information is analyzed and presented, but it has to be kept in mind that due to the number of sources its validity may be small. On the basis of the available information it can be concluded that in the organization there was:

Case Lite City	Room for reflection and metacognition	Stimulation of participation in external knowledge networks
Description	No idea is too extreme for them. They are working with ideas about which we normally say they are not possible. In the beginning we sat down together to think about the project and about ways to approach it. There was quite some time pressure on the project.	They had their network and I had mine and we put the together, They always work together with people who have knowledge they can use but who are flexible thinkers,
Result	<i>High to medium</i>	<i>High</i>

Display 7.20- Lite City X: Organizational conditions

- *Medium to high room for reflection and meta-cognitive activity:* At the start of the projects there was some time and room for reflection concerning the underlying concepts and the approach to the project. During the process there was more time pressure, leaving

less room for reflection and reconsideration of the chosen concepts and approaches. In general there was room for members of the internal circle to bring in new ideas.

- *High stimulation of participation in knowledge networks:* the office discusses and works together with outsiders who have relevant visions and knowledge. Both in creation of innovation and in the process of acceptance of innovations there is a strong focus on building and participating in relevant networks.

7.4 CROSS-SITE CROSS-CASE ANALYSIS

A cross-site cross-case analysis was performed in order to compare the processes underlying the successful radical innovations with the processes taking place in the unsuccessful innovations. In order to perform the cross-site cross-case analysis, additional data analysis was performed. This additional data analysis consisted of a secondary analysis of the data of the first two cases on the basis of the revised conceptual framework. The secondary analysis focussed on an analysis of the data according to the three phases that were discerned. Furthermore the original data were analysed on the basis of the variable related to the reified core concept and on the basis of variables related to information processing (knowledge acquisition, knowledge interpretation, knowledge distribution and knowledge application).

7.4.1 Cross-site cross-case display per phase

The three macro displays (displays 7.3 I till III) contain the results of the cross-site cross-case analysis per phase in the innovation process. These displays give an overview of the occurrence and character of the learning model, the information processing activities and the socio-political processes during the different phases. The labels in the cells are in accordance with the labels used for the analysis per case.

The cases are presented in a way that facilitates the comparison between the successful innovations (cases Medical Education (1) and Pig City (3)) and the unsuccessful innovations (cases Social Sciences (2) and Lite City (4)) as defined on the basis of the analysis of each case.

There was not enough data available to perform an analysis per phase on the organizational conditions for innovation. As a consequence the data on these variables are presented for the processes in general.

Cross-site cross-case analysis idea generation phase																
			Learning model			Information processing			Socio-political processes							
Case	Character	Success	Core Concept	Reflection Conceptualization	Experience style	Learning Goal orientation	Acquisition	Inter-pretation	Distribution	Application	Information change	Foundations for relations	Communication	Relations	Goal orientation	Attitudes
1	Radical	Successful	Orientation Initial development	High/medium	Medium	Experiential Boundary spanning building Personal knowledge	High	High	Low	Low	Open	Open	Open	Medium/closed	Open/medium	Open
3	Radical	Successful	Emerging ideas and vision Development of basic vision	High	Medium/low	Experiential boundary spanning building Problem solving	High	High	Medium/low	High (conceptual)	Open	Open	Open	Open	Open	Open
2	Not radical	Not successful	Development of first lay out	Medium/low	Medium/low	No clear style Problem solving	Low	Low	Low	Low	Closed	Closed	Closed	Closed	Open/medium	Closed
4	Not radical	Not successful	Development of a rudimentary idea	Medium	Medium	Experiential Acquisition Boundary spanning building	Medium	Medium	Medium	Medium	Open/medium	Medium	Medium	Open	Open/medium	Open/medium

Display 7.21: Cross-site cross-case analysis of the idea generation phase

Cross-site cross-case analysis crystallization phase																	
			Learning model			Information processing			Socio-political processes								
									Between groups			Within groups					
Case	Character	Success	Core Concept	Reflection	Experience	Learning style	Goal orientation	Acquisition	Inter-pretation	Distribution	Application	Information	Foundations	Communication	Relationships	Goal orientation	Attitudes
1	Radical	Success-full	Creation Agreement	High/medium	High/medium	Experiential Boundary spanning	Personal knowledge building Problem solving	High	High	High	High	Open/medium	Open/medium	Closed	Open → closed	Open → closed	Open
3	Radical	Success-ful	Creation Agreement	High/medium	Me-dium/low	Experiential Boundary spanning	Personal knowledge building Problem solving	Medium	High	Medium	Medium	--	Open	Medium	Open → closed	Me-dium → Me-dium	Me-dium → Closed
2	Not radical	Not Success-ful	Compromise and reduction	Medium	Me-dium/low	Boundary spanning	Problem solving	High	Me-dium	Medium	High	Me-dium/closed	Closed	Medium/closed	Me-dium/closed	Closed	Me-dium/closed
4	Not radical	Not Success-ful	Diffuse and differentiated No agreement	Me-dium/low	High/medium	Non-experiential	Problem solving Task oriented	Medium	Low	Medium	Low	Medium	Closed	Closed	Me-dium/closed	Me-dium/closed	Me-dium/closed

Display 7.22: Cross-site cross-case analysis of the crystallization phase

Cross-site cross-case analysis evolution phase																		
	Learning model			Information processing			Socio-political processes											
Case	Character	Success	Core Concept	Reflection Conceptualization	Expertise	Learning style	Goal orientation	Acquisition	Interpretation	Distribution	Application	Information Exchange	Foundations for communication	Community relations	Relations	Goal orientation	Attitudes	
1	Radical	Success-full	Clear and agreed-upon core concept	Low/medium	High	Boundary spanning Continuous improvement	Problem solving Task oriented	Medium/low	Low	High	High	Closed	--	Closed	Open	Medium	Open	Open
3	Radical	Success-full	Clear and agreed-upon core concept	Low/medium	Medium/high	Boundary spanning Continuous improvement	Personal knowledge building Task oriented Problem solving	High	Medium	High/medium	High	Medium	Closed	Closed	Medium	Medium	Medium	Medium
2	Not radical	Not successful	Changing concepts	Low/medium	Medium/high	Continuous improvement Boundary spanning	Problem solving	Low	Medium/low	Medium	Medium	Closed	Closed	Closed	Closed	Closed	Closed	Closed
4	Not radical	Not successful	No agreed core concept	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Display 7.23: Cross-site cross-case analysis of the evolution phase

Cross-site cross-case analysis organizational conditions		Stimulation of participation in external knowledge networks	
Case	Room for reflection and metacognition	Low	High
1	Medium to low	Low	High
3	Medium	Low	High
2	Medium to low	Low	High
4	High to medium	Low	High

Display 7.24: Cross-site cross-case analysis of organizational conditions

7.4.2 Cross-site cross-case analysis of the innovation process

We consider the innovation process on the basis of our first revision as a process that takes place in different phases with different characteristics in relation to our variables. These phases however form a continuum in which the underlying processes develop in a certain way. In order to describe these developments according to our variables and in order to compare the development of these processes between the successful and unsuccessful innovations, we also analysed the data on the basis of the consecutive phases.

In display 7.20-7.24 we give an analysis of the activities and the development of the reified core concept during the consecutive phases. In displays 7.25-7.29 we give a description of the development respectively of the learning model, the information processing activities, and the socio-political processes between groups and within groups.

Innovation process for successful and unsuccessful innovations: Activities and core concept

Phase	Activities				Core concept			
Idea generation	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
	External orientation	Noticing developments and problems	Development of ideological ideas	Noticing emerging problems	Orientation	Emerging ideas and vision	Development of first lay out	Development of a rudimentary idea
	Sharing views and knowledge	Discussions in external network	Development first lay out	Internal and external questioning of dominant paradigm	Initial development	Development of basic vision		
	Testing of initial ideas	Developing initial ideas	Developing rudimentary concept in context of different projects	Developing basic idea				
Crystallization	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
	Clarification of core concept	Reframing subject in new perspective	Realisation of compromise between original plan and other views	Developing different approaches and applications of the concept	Creation of core concept	Creation of a core concept	Compromise to the lay out	Diffuse and differentiated application of the basic ideas
	Development of major constituting parts	Clarifying project in leading concepts of the office	Combination between plan and existing approaches	Discussion of applications and concept in external network	Agreement	Agreement	Reduction of initial plans	No agreement on concept and applications
		Developing basic ideas for prototype	Reduction of plan to part of the curriculum	No acceptance of concept and applications in external network				
Evolution	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
	Implementation and adjustment of innovation	Working out of concept in detailed plans	Continuous change of innovation	None	Clear and agreed upon core concept	Clear and agreed upon core concept	Application of changing concepts	No agreed core concept
	Testing of improvement and adjustments in context of concept	Research of knowledge that contribute to innovation	Realisation of incremental innovations in context of other developments		Improvements and adjustments made to innovation in the context of the core concept	Integrating and transforming knowledge in the context of the core concept into final product	Final product changes frequently along different lines	No final products
		Integrating and transforming knowledge in final product				Combination of core concept with other concept lines		

Display 7.25: Cross-site cross-case analysis of development of activities and core concept during the innovation process

Innovation process for successful and unsuccessful innovations: Learning model																			
Phase	Reflection/Conceptualization				Experience				Learning Style				Goal orientation						
	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4			
Idea generation	High/medium	High	Medium/low	Medium	Medium/low	Medium/low	Medium	Medium	Experiential Boundary spanning	Experiential Boundary spanning	No clear style	Experiential Acquisition Boundary spanning	Personal knowledge building	Personal knowledge building	Personal knowledge building	Problem solving	Problem solving	Personal knowledge building	
Crystallization	High/medium	High/medium	Medium/low	Medium	High/medium/low	Medium/low	High/medium	High/medium	Experiential Boundary spanning	Experiential Boundary spanning	Experiential	Non experiential	Personal knowledge building	Personal knowledge building	Personal knowledge building	Problem solving	Problem solving	Problem solving	Task oriented
Evolution	Low/medium	Low/medium	Low/medium	--	High	Medium/high	Medium/high	--	Boundary spanning Continuous improvement	Boundary spanning Continuous improvement	Continuous improvement	--	Problem solving	Personal knowledge building	Personal knowledge building	Problem solving	--	Problem solving	Task oriented

Display 7.26: Cross-site cross-case analysis of development of the learning model during the innovation process

Innovation process for successful and unsuccessful innovations: Information processing												
Phase	Knowledge acquisition				Knowledge interpretation				Knowledge distribution		Knowledge application	
	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
Idea generation	High	High	Low	Medium	High	High	Low	Medium	Low	Medium/low	Low	Medium
Crystallization	High	Medium	High	Medium	High	High	Medium	Low	High	Medium	High	Low
Evolution	Medium/low	High	Low	--	Low	Medium	Medium	--	High	High	High	Medium

Display 7.27: Cross-site cross-case analysis of development of information processing activities during the innovation process

Innovation process for successful and unsuccessful innovations: Socio-political processes between groups												
Phase	Information exchange				Foundations for relations				Character of communication			
Idea generation	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
	Open	Open	Closed	Open/medium	Open	Open	Closed	Medium	Open	Open	Closed	Medium
Crystallization	Open/medium	--	Medium/closed	Medium/closed	Open/medium	Open	Closed	Closed	Closed	Medium	Medium/closed	Closed
	Closed	Medium	Closed	--	--	Closed	Closed	--	Closed	Medium	Closed	--
Evolution												

Display 7.28: Cross-site cross-case analysis of development socio-political processes between groups during the innovation process

Innovation process for successful and unsuccessful innovations: Socio-political processes within groups												
Phase	Relations				Goal orientation				Attitudes			
Idea generation	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4	Case 1	Case 3	Case 2	Case 4
	Medium/Closed	Open	Closed	Open	Open/medium	Open	Open/medium	Open/medium	Open	Open	Closed	Open/medium
Crystallization	Open → closed	Open → closed	Medium/closed	Medium/closed	Open → closed	Medium	Closed	Medium/closed	Open → closed	Medium → closed	Medium/closed	Medium/closed
	Open	Medium/closed	Closed → open	--	Medium	Medium	Closed → open	--	Open → closed	Medium/closed	Closed → open	Closed → open
Evolution												

Display 7.29: Cross-site cross-case analysis of development of socio-political processes within groups during the innovation process

8. CONCLUSION AND DISCUSSION CROSS-SITE CROSS-CASE ANALYSIS

This chapter presents tentative conclusions for our research project. We do this by presenting the variables in the light of the findings from our four case studies and confronting the propositions with these findings. This chapter serves as the conclusion for the first part of our study: the *descriptive part* aimed at the development of a conceptual framework for radical innovation in KISFs.

On the bases of the discussion of variables and propositions and the tentative treatment of research questions, we enter the second part of this study: the *prescriptive part* aimed towards the development, application and evaluation of a process design model for radical innovation in KISFs (chapters 9, 10, 11 and 12).

8.1 CONCLUSIONS

We start this chapter with conclusions on each variable in the light of the empirical findings from our cases. This is done for each variable in terms of its development during the different phases of the innovation process. In this way the innovation process is not only described in terms of 'static moments', but also as an evolution of processes taking place.

The main variables that are examined: Radical innovation: function and success of innovation, phases of innovation (idea generation, crystallization and incremental innovation), reified core concept, learning model (refined into reflection and conceptualization, experience, learning style and goal orientation), information processing activities (refined into knowledge acquisition, knowledge interpretation, knowledge distribution and knowledge application), socio-political processes (refined into processes between groups, described by the variables information exchange, foundations for relations, characteristics of communication and processes within groups, described by the variables relations, goal orientation and attitudes), room for reflection and meta-cognitive activities and stimulation of participation in knowledge networks.

Success and function of the innovation

CASE	SUCCESS	RESULT	FUNCTION	RESULT
Medical Education	Implementation realized 2 nd year of execution Initial goals realized No clear view on pay offs Considered success by relevant others	Successful	Basis for developments and incremental innovations New concept in professional field (national level) Generalized to wider community Improvement of professional status	Radical
Pig City	Small scale use; feasibility study performed No duration of life: but subject turned from conversation piece into a serious solution Has improved the status of the firm in line with strategic intent (firm of ideas) Considered success by relevant others	Successful	Is a basis for a new line of concepts Considered as an important step in the acceptance of the subject International media attention and attention in professional and political communities Has increased professional status of the firm	Radical
Social Sciences	Implemented Gross changes in concept in 7 years (abandoned after 7 years) Difused goals, some realized, some not No clear pay offs Not considered successful by relevant others (and negative impressions by some)	Not successful	No basis for developments and incremental innovations Has not led to new insights in the professional field Not generalized to relevant others No improvement of professional status	Not radical
Lite City	Only rough sketches has not been realized goals: a step in the spiral of development, but not final concept has (not yet) been accepted by clients	Not successful	Recently influenced further developments in a light way No new insights in the professional community as yet Our name is not attached to the changes in this direction	Not radical

Display 8.1: Success and function of the innovation

The cases Medical Education and Pig City have 3 positive scores on the 4 criteria concerning the success of the innovation. The cases Social Sciences and Lite City have one positive score on the degree of success.

The cases Medical Education and Pig City also have 3 or more positive scores on the 4 criteria concerning the radical character of the innovation. The cases Social Science and Lite City have only one or two positive scores on the criteria related to the radical function of the innovation.

The scores are consistent with the definition of the cases as stated beforehand by the persons who introduced the cases. The cases Medical Education and Pig City are considered as successful radical innovations, whereas the cases Social Sciences and Lite City are considered as not successful, not radical innovations.

8.1.1 Phases in the innovation process

Idea generation phase

In all 4 cases there is an idea generation phase that consists of focussing on the issue at hand (the 'innovative issue' or the issue asking for innovation) and the development of rudimentary concepts or initial ideas. The cases differ in the degree of acquisition of (external) knowledge and the interpretation of this knowledge into broad visions. In the cases Medical Education and Pig City there is much acquisition of knowledge in external networks and more shared interpretation of this knowledge leading to broad visions underlying the innovation. In the cases Social Sciences and Lite City there is little acquisition of external knowledge and especially little collective interpretation of this knowledge into new broad visions.

Crystallization phase

Although in all cases some sort of crystallization phase exists, the character of this phase differs for the successful and the not successful innovations. In the cases Medical Education and Pig City, the emphasis in the crystallization phase is on development of a core concept and the 'simultaneous' clarification and agreement of this core concept in the group of relevant actors (strategic circle). On the basis of this agreed-upon and clarified concept more substantial ideas for the actual innovation are developed. In the cases Social Sciences and Lite City the crystallization phase is characterized by either developing compromises on the original plan or by the development of more diffuse and differentiated plans in the context of the original ideas. This appears adverse to any further clarification of the core concept. In these cases no agreement on an underlying core concept was realized.

Evolution phase

In the cases Medical Education and Pig City there was an evolution phase characterized by developing and implementation of detailed plans in the context of the core concept. The actual innovation was developed and realized. Knowledge and experience in the organization and newly acquired knowledge was reframed in the context of the core concept and subsequently applied in the realization and further adjustment and improvement of the innovation. In the case Pig City the definition of the core concept and the realization of the innovation led to lines of new conceptual developments (simultaneous with the realization of the innovation). In the case Medical Education the realization of the innovation led to new developments in the line of the chosen core concept.

In the case Lite City the evolution phase was never reached. Differentiated plans were developed on the basis of the basic ideas, but were not accepted for realization. In the case Social Sciences the evolution phase was characterized by a continuous change of the innovation, by compromises and the threat of abolishment. In the end the innovation was abolished. The fact that we have data on only one unsuccessful case for the evolution phase asks for caution concerning the external validity of the study for this phase. In the research study the logic of replication is realized by *literal replication* (cases predicting similar results) and *theoretical replication* (cases

producing contrasting results for predictable reasons). As only one contrasting case is analyzed for the evolution phase, external validity for this phase is reduced. However, as there is literal replication from the two successful cases and some theoretical replication in the one unsuccessful case, it was decided that findings can still be presented, notwithstanding their lessened external validity.

Clarity and sequence of the phases

Although the phases are distinctive in terms of character, they are not clearly distinctive in terms of length and sequence. There is no clear differentiation between the end of one phase and the start of a new phase. In this sense the phases are more a superficial labelling of characteristic differences in the innovative process than conscious steps being taken by the actors in the process. No one in the research project mentions the use of different phases, or moves from one phase to the other. Sometimes two phases occur within the same time frame. In the case Lite City there are characteristics of the evolution phase in the phase which is mainly characterized as the idea generation phase. In the case Social Sciences, actualization (as a characteristic of the evolution phase) and crystallization are more or less interactive, crystallization precedes actualization, but the introduction of new interventions requires renewed crystallization activities. In the case Pig City the crystallization phase is followed by both the actualization of the concept of Pig City and at the same time by a new idea generation phase, where the concept is combined with other concepts leading to new innovations. It becomes clear from the research results that in the successful cases, the idea generation phase and the crystallization phase are completed in a satisfactory way and with a positive result. This seems to be a necessary condition for the creation of successful radical innovations.

8.1.2 Core concept

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Orientation Initial development	Creation of a core concept Agreement Reified core concept	Reified core concept Serves as a basis for incremental innovation
	Pig City	Emerging ideas Development of basic vision	Creation of a core concept Agreement Reified core concept	Reified core concept Reframing knowledge in context of core concept into final product Combination of core concept with other lines
Not successful	Social Sciences	Development of first lay out	Compromise of lay out Reduction of initial plans No reified core concept	Application of changing concepts Frequently changing final concept
	Lite City	Development of rudimentary ideas	Diffuse and differentiated application of basic ideas No reified core concept	No reified core concept No final products

Display 8.2: Reified core concept

In the cases Medical Education and Pig City there is a reified core concept providing a frame of reference for the innovative actions. This core concept is agreed upon by relevant actors. It serves the function of both a frame for the actual realization of the innovation and a basis for communication on the innovation to relevant others. As a frame of reference it is a basis for knowledge interpretation and application. Realization, improvements and adjustments are placed in this frame of reference. In the case Pig City the concept is moulded with other concept into new frames, leading to new developments (and thus new concepts).

In the cases Social Sciences and Lite City rudimentary ideas of the core concept are formulated. These are, however, never fully developed into a core concept. In both cases the basic ideas are either presented in differentiated and diffused form or are reduced to lower levels of aspiration. In both cases it was not possible to reach agreement on the core concept between the relevant actors. It is not clear whether a lack of agreement leads to differentiation and reduction or whether the lack of clarification prevents agreement.

During the three phases in the successful cases, the development of the core concept proceeds along the following lines:

- Idea generation phase:
 - orientation
 - initial development of a basic vision
- Crystallization phase:
 - creation of a clearly defined core concept
 - negotiation and agreement on this core concept by relevant actors (opinion leaders and decision makers)
- Evolution phase:
 - use of the core concept as a frame of reference for the development and implementation of the actual innovations
 - core concept is the touchstone for adjustments and further improvements
 - further developments on the basis of the innovation in the context of the core concept

8.1.3 Learning model

Reflection and conceptualization

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	High/medium	High/medium	Low/medium
	Pig City	High	High/medium	Low/medium
Not successful	Social Sciences	Medium/low	Medium	Low/medium
	Lite City	Medium	Medium/low	--

Display 8.3: Reflection and conceptualization

There is a difference in reflection and abstractive processing between the successful and the unsuccessful cases. This difference is most clear in the idea generation phase and in the crystallization phase. In the cases Medical Education and Pig City, reflection and conceptualization is high in the idea generation phase and high to medium in the crystallization phase. In the cases Social Sciences and Lite City reflection and conceptualization varies between medium and low in both phases. In the evolution phase, reflection and conceptualization is low to medium in all cases, both successful and unsuccessful. This points to a positive influence of high levels of reflection and conceptualization in the first two stages of the innovation process and no differential role in the last phase of the process.

From the findings it can be concluded that in successful innovations reflection and conceptualization move from high levels in the idea generation phase to medium high levels in the crystallization phase and low to medium levels in the evolution phase.

Experiences

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Medium	High/medium	High
	Pig City	Medium/low	Medium/low	Medium/high
Not successful	Social Sciences	Medium/low	Medium/low	Medium/high
	Lite City	Medium	High/medium	--

Display 8.4: Use of experiences

There are no differences concerning the use of experience between the successful and the unsuccessful cases. This does not mean that experience plays no role in the innovative process, but that the use of experience in the process does not have a differentiating effect on the success of the innovation.

In all cases the use of experience moves from low to medium in the development phase, to medium in the crystallization phase, and to high to medium in the realization phase.

Learning style

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Experimental Boundary spanning	Experimental Boundary spanning	Boundary spanning Continuous improvement
	Pig City	Experimental Boundary spanning	Experimental Boundary spanning	Boundary spanning Continuous improvement
Not successful	Social Sciences	No clear style	Experimental	Continuous improvement Boundary spanning
	Lite City	Experimental Acquisition Boundary spanning	Non-experimental	--

Display 8.5: Learning style

There are slight differences between the learning style used in the successful and unsuccessful cases. In the cases Medical Education and Pig City the learning style, especially in the idea generation and crystallization phase, is a combination of an experimental style and boundary spanning. The learning style is consistent in both cases during the two phases. In the cases Social Sciences and Lite City, the learning style varies strongly between and within the cases. It varies between a mix of experimental, acquisition and boundary spanning in Lite City, with no clear style in Social Sciences in the idea generation phase, to non-experimental¹ in Lite City and experimental in Social sciences in the crystallization phase. In the evolution phase the cases Medi-

¹ Although non-experimental was no variable in the study, the character of the learning style used is opposite to the character of the experimental learning style. The learning style used did not fit in with any of the other variables. As such it was considered fitting and illustrative for it to be labelled non-experimental.

cal Education and Pig City are characterized by boundary spanning in the context of continuous improvement, with an emphasis on boundary spanning. In the case Social Sciences there is a mixture between continuous improvement and boundary spanning with an emphasis on continuous improvement.

From the findings it can be concluded that successful innovations ask for a combination of experimental learning and boundary spanning in the idea generation and crystallization phase. In general boundary spanning is related to knowledge acquisition from outside the organization and experimentation is used to combine and interpret knowledge from within the organization and acquired knowledge into new frames of reference (see also 6.1.4). In the evolution phase successful innovation is characterized by using experiences and insights from other organizations (boundary spanning) in order to realize continuous improvement of the innovation within the new frame of reference.

Goal orientation

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Personal knowledge building	Personal knowledge building Problem solving	Problem solving Task oriented
	Pig City	Personal knowledge building Problem solving	Personal knowledge building Problem solving	Personal knowledge building Task oriented Problem solving
Not successful	Social Sciences	Problem solving	Problem Solving	Problem solving
	Lite City	Personal knowledge building Problem solving	Problem Solving Task oriented	--

Display 8.6: Goal orientation

In the cases Medical Education and Pig City, the emphasis in goal orientation is predominantly on personal knowledge building in the idea generation and crystallization phase, in these phases there is a secondary goal orientation on problem solving. In the cases Social Sciences and Lite City the primary goal orientation in the idea generation and crystallization phase is on problem solving (combined with no secondary goal orientation or a secondary goal orientation directed towards either personal knowledge building or task orientation). This problem solving goal orientation was geared towards the solution of multiple problems or project requests. In the successful cases the goal orientation was more focused on one theme. In the evolution phase goal orientation is more differentiated, with a focus on a combination of problem solving and task orientation in the cases Medical Education and Pig City, and of problem solving alone in the case Social Sciences. In Pig City the goal orientation in the evolution phase also emphasized personal knowledge building; this can be a result of the fact that in this case the crystallization phase led to both realization and new developmental activities. Actors in this stage were working on both of these activities.

In general it can be concluded from the findings that successful innovation asks for a goal orientation that is primarily focussed on personal knowledge building and secondarily on problem solving during both the idea generation and crystallization phase. Goal orientation moves towards a stronger problem solving goal orientation in the evolution phase.

8.1.4 Information processing activities

Knowledge acquisition

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	High	High	Medium/low
	Pig City	High	Medium	High
Not successful	Social Sciences	Low	High	Low
	Lite City	Medium	Medium	--

Display 8.7: Knowledge acquisition

In the cases Medical Education and Pig City, there is a high level of external knowledge acquisition in the idea generation and crystallization phase. In the evolution phase the level of knowledge acquisition differs strongly for both cases, being medium/low in one case and high in the other. There is an interesting difference in the character of acquired knowledge during the different phases. In the idea generation phase the emphasis is on abstract knowledge at a conceptual level. New knowledge is sought that lies outside the existing paradigms used in the organisation. In the evolution phase acquisition of new knowledge focuses on knowledge related to actual experiences related to the new frame of reference as defined by the core concept. In the cases Social Sciences and Lite City levels of knowledge acquisition are low to medium in the idea generation phase, high to medium in the crystallization phase and low in the evolution phase.

From the findings it can be concluded that successful innovation asks for high levels of knowledge acquisition, especially in the idea generation phase, with a focus on abstract knowledge that provides the opportunity to move outside existing frames of reference. In the evolution phase there is less need for knowledge acquisition, but acquired knowledge has to focus on more experience-based knowledge that lies within the new frame of reference (knowledge and experiences that can be used to test the appropriateness of certain elements of the innovation).

Knowledge interpretation

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	High	High	Low
	Pig City	High	High	Medium
Not successful	Social Sciences	Low	Medium	Mediumlow
	Lite City	Medium	Low	--

Display 8.8: Knowledge interpretation

The patterns for knowledge interpretation parallel those for knowledge acquisition, but there is a stronger emphasis in the crystallization phase. In parallel to knowledge acquisition, there are in

the idea generation phase high levels of interpretation for the cases Medical Education and Pig City and medium to low levels for the cases Social Sciences and Lite City. In the crystallization phase, there is a strong difference between knowledge interpretation and knowledge acquisition between the successful and unsuccessful cases. Knowledge interpretation is high in the successful cases, but medium to low in the unsuccessful cases. In the evolution phase knowledge interpretation is medium to low for all four cases.

From the findings it can be concluded that in successful innovations there is a high level of interpretation of acquired knowledge in both the idea generation and crystallization phase, with interpretation reduced to medium to low levels in the evolution phase.

Knowledge distribution

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Low	High	High
	Pig City	Medium/low	Medium	High/medium
Not successful	Social Sciences	Low	Medium	Medium
	Lite City	Medium	Medium	--

Display 8.9: Knowledge distribution

In the cases Medical Education and Pig City knowledge distribution is low in the idea generation phase, increasing during crystallization to high to medium and increasing further to high during the evolution phase. This pattern also appears in the cases Social Sciences and Lite City but is less evident, as knowledge distribution moves from low-to-medium in the idea generation phase to medium in the crystallization and evolution phase. In the idea generation phase there is no difference between the successful and not successful cases, in the crystallization phase and evolution phase there is a clear difference, with distribution being at higher levels in the successful cases.

From the findings it can be concluded that in successful innovations, knowledge distribution is low in the idea generation phase and increases respectively to medium-high and high levels in the crystallization phase and evolution phase.

Knowledge application

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Low	High	High
	Pig City	High (conceptual)	Medium	High
Not successful	Social Sciences	Low	High	Medium
	Lite City	Medium	Low	--

Display 8.10: Knowledge application

The pattern for knowledge application follows the pattern for knowledge distribution but is more differentiated. In the cases Medical Education and Pig City, knowledge application differs from low to high (at a conceptual level) in the idea generation phase. In the cases Social Sciences and

Lite City, knowledge application in the idea generation phase is low-to-medium. In the crystallization phase knowledge application in the cases Medical Education and Pig City is high-to-medium, in the cases Social Sciences and Lite City it differs between high and low. In the evolution phase knowledge application is high for the cases Medical Education and Pig City and medium for the case Social Sciences.

In general it can be concluded that knowledge application in successful innovations broadly follows the path of knowledge distribution, starting at a medium level in the idea generation phase and increasing to medium-high and high levels in the crystallization and evolution phase.

8.1.6 Socio-political processes

Between groups

In general the interactive processes and politics between different groups are much more open in successful radical innovations than in unsuccessful, not radical innovations. In the cases Medical Education and Pig City the interactive and political processes move from open in the idea generation phase to an intermediate level between open and closed in the crystallization phase and a closed character in the evolution phase. In the cases Social Sciences and Lite City the processes move from medium to closed in the idea generation phase to closed in the crystallization and evolution phase.

In the cases Medical Education and Pig City different groups or circles are involved in the different phases, leading to interactive processes between these different groups. In the idea generation phase there is a leading role for the innovator, who is a member of the organization and functions as a gatekeeper between the external network and the organization. In relation to this gatekeeper there is also a central role for the external network, consisting of other professionals and opinion leaders who are all part of one or sometimes different external networks (closely or loosely coupled). In this phase there is also a boundary spanning role for senior management in being the receivers (and as such acceptors or deniers) of new ideas imported from outside (in the case Pig City the person of the innovator had also a role as senior manager). In the crystallization phase there is in the cases Medical Education and Pig City a dominant role for senior management and leading professionals from within the organisation or senior management and leading professionals in combination with external stakeholders. Relevant parties in the evolution phase are in all cases the internal circle, responsible for realization of the plans within the framework of the core concept. However, depending on the area of effect of the innovation (within or outside the organisation), there is also a role for external policymakers and decision-makers (and in that sense future users), who have a strong role in accepting the innovation and deciding on its implementation.

Information exchange

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Open	Open/medium	Closed
	Pig City	Open	--	Medium
Not successful	Social Sciences	Closed	Medium/closed	Closed
	Lite City	Open/medium	Medium/closed	--

Display 8.11: Political processes between groups – Information exchange

In line with the general pattern for interactive and political processes between groups, there is in the character of information exchange, in the cases Medical Education and Pig City an open information exchange in the idea generation phase. The exchange changes to open to medium in the crystallization phase and medium to closed in the evolution phase. In the cases Social Sciences and Lite City, there is a differentiated pattern in information exchange in the idea generation phase (closed in one case, open to medium in the other case). In the crystallization phase information exchange is medium closed and in the evolution phase it is closed.

Foundations for relations

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Open	Open/medium	--
	Pig City	Open	Open	Closed
Not successful	Social Sciences	Closed	Closed	Closed
	Lite City	Medium	Closed	--

Display 8.12: Political processes between groups – Foundations for relations

In general the pattern of foundations for relations in the successful cases follows the pattern for information exchange, although there is a less clear pattern for the case Medical Education in the evolution phase. In the cases Medical Education and Pig City foundations for relations are open in the idea generation phase, open (to medium open) in the crystallization phase and closed (Pig City) in the evolution phase. In the cases Social Sciences and Lite City, foundations of relations are generally closed in all phases pointing to a high degree of influence on relations by existing coalitions rather than by added value. The idea generation phase in these cases is slightly more open (closed to medium) than other phases.

Character of communication

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Open	Closed	Closed
	Pig City	Open	Medium	Medium
Not successful	Social Sciences	Closed	Medium/closed	Closed
	Lite City	Medium	Closed	--

Display 8.13: Political processes between groups – Character of communication

The character of communication in the cases Medical Education and Pig City is open in the idea generation phase, but medium to closed in both the crystallization and evolution phase. Whereas communication is still characterized by dialogue in the idea generation phase, it is closed down to communication on the basis of assumptions within the created frame of reference during both the crystallization and evolution phase. In the cases Social Sciences and Lite City the character of communication is medium-to-closed during the idea generation phase, becoming more closed during the crystallization and evolution phase.

In general it can be concluded that for successful innovation there is, in the idea generation phase, a need for open interactive and political processes between gatekeepers and the external network. This requires permeable borders between different groups, frequent exchange of information with outsiders, relations in the network influenced by added value and communication based on dialogue. In the crystallization phase there is a need for medium open processes between gatekeepers, senior management and leading professionals (boundary spanners) and possibly external stakeholders. This asks for medium-open boundaries, regular information exchange, relations influenced by added value and communications within the framework of the agreed-upon core concept. In the evolution phase there are more closed interactive and political processes between the innovator, management, the internal circle (project team) and possible outsiders. This asks for medium-closed boundaries and more limited exchange of information with outsiders, for relations influenced by existing coalitions (coalitions within the context of the new framework) and for communications that are based on assumptions from the new framework, but that can be, within the boundaries of this framework, more open in character.

Within groups

Interactive and political processes within groups have different patterns during different phases but are generally moving from open to more closed. In successful cases communication within groups is open in the idea generation phase, in the crystallization phase it moves from open to closed, in line with clarification of the core concept and the realization of agreement. In the evolution phase there is no clear picture for the interactive and political processes, but in general the processes vary between medium and medium closed. In the unsuccessful cases the processes within groups move from medium in the idea generation phase to medium-closed in the crystallization phase. In the evolution phase there is a move from closed to open processes (related to only one case).

In this study processes in the idea generation phase concerned the processes within the external network. In the crystallization phase processes concerned either the strategic circle, consisting of innovator, senior management and leading professionals in the organisation, or the innovator and groups of external stakeholders and professionals. In the evolution phase, processes concerned the internal circle or project team responsible for the realization of the innovation.

Relations

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Medium/closed	Open → closed	Open
	Pig City	Open	Open → closed	Medium/closed
Not successful	Social Sciences	Closed	Medium/closed	Closed → open
	Lite City	Open	Medium/closed	--

Display 8.14: Political processes within groups – Relations

For the cases Medical Education and Pig City there is a differentiated picture on relations in the idea generation phase, varying from medium-to-closed in Medical Education to open in Pig City. In the cases Social Sciences and Lite City relations vary from closed to open. In the crystallization phase relations develop from open to closed in the cases Medical Education and Pig City. In the cases Social Sciences and Lite City relations are medium closed in this phase. In the evolution phase there is again a differentiated picture for the cases Medical Education and Pig City, relations varying between open and medium closed. In the case Social Sciences relations moved from closed to open in this phase.

Goal orientation

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Open/medium	Open → closed	Medium
	Pig City	Open	Medium	Medium
Not successful	Social Sciences	Open/medium	Closed	Closed → open
	Lite City	Open/medium	Medium/closed	--

Display 8.15: Political processes within groups – Goal orientation

There is no difference in goal orientation between the successful and unsuccessful cases during the idea generation phase. The processes in the cases move between open and medium. In the crystallization phase there is some difference between the successful and unsuccessful cases. In the successful cases there is a differentiated picture as goal orientation moves from open to closed in Medical Education and lingers around medium in Pig City. In the cases Social Sciences and Lite City the goal orientation is closed. In the evolution phase goal orientation is medium in the cases Medical Education and Pig City and moves from closed to open in the case Social Sciences.

Attitudes

	Case	Idea Generation	Crystallization	Evolution
Successful	Medical Education	Open	Open → closed	Open → closed
	Pig City	Open	Medium → closed	Medium/closed
Not successful	Social Sciences	Closed	Medium/closed	Closed → open
	Lite City	Open/medium	Medium/closed	--

Display 8.16: Political within groups – Attitudes

In the cases Medical Education and Pig City attitudes within groups are open in the idea generation phase, move from open/medium to closed in the crystallization phase, and are differentiated in the evolution phase (either moving from open to closed or being medium-closed). In the cases Social sciences and Lite City the attitudes within groups are differentiated in the idea generation phase (closed and medium open), are medium closed in the crystallization phase, and move from open to closed in the evolution phase.

In general it can be concluded that for successful innovations there is a need for open interactive and political processes within the external network in the idea generation phase. This is related especially to a collective goal orientation that focuses on the development of new knowledge and methods and on an investigative and entrepreneurial attitude. Bindings related to protection of status quo, compliance to group norms and values, and the selection of members on the basis of political relations play a less important role. In the crystallization phase successful innovation requires a closing down of processes within the strategic circle, since during this phase the concept is clarified and agreement is being reached. During this process there is a stronger need for compliance to group norms and values (compliance to the new frame of reference), and members of the strategic circle are more important in terms of their political status (the ability to influence others in the organisation). Goal orientation proceeds from developing new knowledge and methods towards optimizing knowledge and methods within the chosen frame of reference. The attitude becomes more defensive in order to protect the new frame of reference, and is more optimizing than entrepreneurial. The proceedings of interactive and political processes during the evolution phase (for the internal circle or the project team) are varied, pointing to the diminishing impact of the openness of processes in this phase on the success of the innovation.

8.1.7 Organizational conditions

Room for reflection and meta-cognitive abilities

	Case	Room for reflection and meta-cognitive abilities
Successful	Medical Education	Medium to low
	Pig City	Medium
Not successful	Social Sciences	Medium to low
	Lite City	High to medium

Display 8.17: Room for reflection and meta-cognitive abilities

The results on the variable room for reflection and meta-cognitive abilities are differentiated for all cases. The successful cases vary between medium-to-low and medium on this item. The unsuccessful cases vary between medium-to-low and high-to-medium. Consequently no conclusions can be drawn on the effect of room for reflection and meta-cognitive abilities for the degree of success of the innovative process. It has to be noted, however, that this variable concerns the actual active provision of the organization for room for reflection and meta-cognitive abilities and does not concern the actual room for this in the projects (this issue is addressed under the headings of reflection and conceptualization, learning style and goal orientation, and attitudes in relation to socio-political processes within groups).

Stimulation of participation in knowledge networks

	Case	Stimulation of participation in knowledge networks
Successful	Medical Education	Low
	Pig City	High
Not successful	Social Sciences	Low
	Lite City	High

Display 8.18: Stimulation of participation in knowledge networks

The results on the variable stimulation of participation in knowledge networks are differentiated for all cases. The successful cases vary between low and high on this item. The unsuccessful cases vary also between low and high. Therefore no conclusions can be drawn on the effect of the stimulation of participation in knowledge networks for the degree of success of the innovative process. It has to be noted, however, that this variable concerns the actual active stimulation by the organization of participation in knowledge networks and does not concern the actual participation (this issue is addressed under the headings of knowledge acquisition and socio-political processes between groups).

8.2 FINDINGS RELATED TO THE PROPOSITIONS

In this section we relate the findings to the revised propositions, as formulated in paragraph 6.4. The confrontation of the propositions with our findings from all four case studies is the basis for the development of the process design model that serves as the working model for the second part of this study.

- 1. The process of radical innovations in KISFs is characterized by different phases that can be described successively as the idea generation phase, the crystallization phase and the evolution phase*

This proposition holds, since the successful innovations are characterized by the occurrence of the characteristics described for the three phases. There is no clear demarcation between the three phases, but there is a general tendency towards the sequential occurrence of idea generation, crystallization and evolution in the successful cases. In the unsuccessful cases there is a more diffused pattern in the character of the idea generation and crystallization phase.

Although it was not explicitly studied whether in fact these phases are separate, clearly defined phases, which are strictly sequential in character, or are more like episodes that are iterative, recursive and discontinuous in character, it seems from our findings that the transition from one phase to the other may be rather diffuse. One important remark holds, however: that it is essential for the creation of radical innovations to create a reified and clear core concept. This means that in order to start the evolution phase, both the idea generation and crystallization phase have to be completed in a satisfactory way.

2. *The creation and realization of radical innovations is based on the creation of a reified core concept*

This proposition is confirmed by the comparison between the successful and unsuccessful cases. In the successful cases there is a clear and agreed upon core concept that forms the basis for the actual innovation. In the unsuccessful cases there is no clear concept and there is no agreement on the core concept (reification).

3a. *The creation of radical innovations needs reflection and conceptualization in the organization of externally acquired knowledge*

This proposition can neither be clearly confirmed nor rejected on the basis of this study, as no analysis was performed on the concurrence of data. There was, however, a concomitant occurrence of high levels of reflection and conceptualization, high levels of knowledge acquisition and interpretation, and medium-to-low levels of use of experience. As such it seems plausible to assume that there is a positive relation between the reflection and conceptualization of externally acquired knowledge and the creation of radical innovations. This positive relation is strongest during the idea generation phase. The reflection and conceptualization of externally acquired knowledge may form the basis for the creation of a reified core concept.

3b. *The creation of radical innovations demands for processing of the reified core concept on the basis of experiences from the primary process by professionals in the evolution phase*

This proposition cannot be clearly confirmed or rejected on the basis of this study, as no analysis was performed on the concurrence of these data. Analysis shows that the activities concerning the reified core concept during the evolution phase are related to development and implementation of the innovation and adjustments and improvements. This is commensurate with high levels of use of experience and high levels of knowledge application. The levels for these variables are medium-to-high and medium in the unsuccessful cases. It does not therefore seem plausible to confirm this proposition.

4a. *The creation of radical innovations asks for an experimental learning style in the idea generation phase*

This proposition is confirmed, but needs some elaboration. In the successful cases there is indeed an experimental learning style in the development phase, but this style is in both cases combined with a boundary spanning learning style. In general this combination is related to the information processing activities of knowledge acquisition (combination of boundary spanning and experimental learning style) and the subsequent interpretation of this knowledge within the setting of the organization and the innovation process (a more experimental style). Related to the two styles is an emphasis on the experimental style as compared to the boundary spanning style.

4b. *The creation of radical innovations requires a continuous improvement learning style in the evolution phase*

This proposition is partly rejected. From the findings it appears there is in both the successful and unsuccessful cases a learning style aimed at continuous improvement in the evolution phase. In the successful cases this style is, however, dominated by a boundary spanning learning style. The emphasis is on learning from and using experiences from other organisations and settings. This style is geared towards improvements and adaptations in the context of the innovation. As such, there is no pure continuous improvement learning style, but there is a combination of boundary spanning and continuous improvement in the evolution phase.

5a. *The creation of radical innovation asks for a personal knowledge building goal orientation in the in the idea generation phase*

This proposition is confirmed by research findings where a personal knowledge building goal orientation dominates the idea generation phase in the successful cases and a problem solving goal orientation dominates the idea generation phase of the unsuccessful cases. In both successful cases the personal knowledge building orientation is combined with a secondary problem solving orientation, as there is an orientation towards the issue of the innovation and the underlying situation. As a consequence, elaboration of this hypothesis is needed in the direction of combination of a personal knowledge building and a focus towards solving of broader underlying problems in the idea generation phase.

5b. *The creation of radical innovation demands for a problem solving goal orientation in the evolution phase*

This proposition is neither confirmed nor rejected on the basis of the research findings. There is a problem solving goal orientation in the evolution phase of the successful cases, but this orientation is combined with other strategies and is dominant in only one of the cases. The unsuccessful case is also dominated by a problem solving goal orientation in the evolution phase. Thus, although rejection is not relevant, and problem solving plays a role in the evolution phase, this proposition appears to have little 'predictive value' for the success of incremental innovation building in this phase. It appears that the goal orientation in this phase is diverse, with some emphasis on problem solving in combination with task orientation.

6. *The influence of open or closed socio-political processes varies during the process of innovation:*

- a. *In the idea generation phase the creation of radical innovations is positively influenced by open socio-political processes among and within the relevant groups***

This proposition is confirmed for the political processes among and within relevant groups. There is a stronger relation between open political processes among groups and the success of the idea generation phase, than there is between open political processes within groups and the success of the idea generation phase. This seems to be the case when there is a strong emphasis on successful knowledge exchange between the organization and the external knowledge net-

work in this phase, for there has to be an open relation between (the participants in) the external knowledge network and the gatekeeper in the organization.

- b. *In the crystallization phase the creation of radical innovations is positively influenced by socio-political processes that move from open to closed among and within relevant groups***

This hypothesis is partly confirmed, partly rejected. For the socio-political process among groups in the crystallization phase, there is a tendency for medium open processes: open-to-medium information exchange, open-to-medium foundations for relations and medium-to-closed character of communication. As there is no clear movement from open to closed, this part of the proposition is rejected. For the socio-political processes within groups the proposition is confirmed, since there is a general tendency towards processes within groups moving from open to close (in 4 out of 6 scores on this issue). Unsuccessful cases distinctly show a tendency towards medium closure on all items related to socio-political processes within groups.

- c. *In the evolution phase the creation of radical innovations is positively influenced by closed socio-political processes among groups and open to closed socio-political processes within relevant groups***

This proposition is rejected, as there is in the successful cases a medium-to-closed socio-political process among groups, in which there is closure in boundaries and information exchange with outsiders, but at the same time more openness concerning communication within the boundaries of the new framework of the core concept and innovation. As such, it seems that the framework of the core concepts determines the boundaries of the field within which open communication can take place.

The second part of the proposition is also rejected, as socio-political processes within groups in the evolution phase are characterized by various positions between open and closed and different movements between open and closed processes (moving from closed to open and from open to closed).

- 7. *The creation of radical innovations needs information processing activities that vary during the process of innovation:***
 - a. *A focus on acquisition and interpretation during the idea generation phase***

This proposition is confirmed. In the successful cases knowledge acquisition and interpretation is high, whereas it is medium to low in the unsuccessful cases. There is also a strong differentiation between knowledge acquisition and interpretation being high in the successful cases and knowledge distribution and application being low-to-medium in the successful case. There is a focus on the processes of knowledge acquisition and interpretation in the idea generation phase. This is related to the role of the external knowledge network, to the activities of the gatekeeper who imports new knowledge into the organization, and to interpretation of this knowledge in the light of the innovative issue.

b. *A focus on acquisition, interpretation, distribution and application during the crystallization phase*

This proposition is confirmed. In the crystallization phase all information processing activities are high, with an emphasis on knowledge interpretation activities. The importance of knowledge interpretation for the success of the innovation process is stressed by the fact that the difference between the successful and unsuccessful cases is the largest for this variable.

c. *A focus on distribution and application during the evolution phase*

This proposition is confirmed as distribution and application activities are high for the successful cases and medium for the unsuccessful cases. The focus seems to be on distributing the new core concept and applying the concept and related knowledge in the primary process.

8. *Radical innovations demand organizational conditions where there is room for the development of reflective and meta-cognitive abilities*

This proposition cannot be clearly confirmed or rejected on the basis of the data, as no relation was found between organizational conditions providing room for the development of reflective and meta-cognitive abilities and the success of the innovative process. This result is to be expected, because the two sets of case-studies, one successful and one unsuccessful, both originated from the same organization. It can be expected then that organizational conditions are equal, but can lead to both successful and unsuccessful innovation. From the research it appears, however, that there is a strong positive influence of high levels of reflection and conceptualization in the idea generation and crystallization phase on the success of the innovation process. It can therefore be concluded that the withdrawal of possibilities for reflection and meta-cognitive abilities may form a hindrance for successful innovation. It is probably important that there is facilitation in terms of creating room for these processes.

9. *Radical innovations demand organizational conditions that stimulate the participation of knowledge networks within and outside the organization*

This proposition cannot be clearly confirmed or rejected on the basis of the data, since no relation was found between stimulation of participation in knowledge networks and the success of the innovative process. The same argumentation that holds for proposition 8 may also hold for this proposition: acquisition of external knowledge is essential for the creation of radical innovations, as such the impediment of participation in knowledge networks must be prevented. The organizational conditions certainly have to provide room for participation in knowledge networks.

Rival propositions:

10. *Radical innovations are formed on the basis of the learning process of social construction*

This rival proposition was not explicitly addressed. From the findings it can be deduced, however, that the idea generation phase shows few characteristics that are essential elements of so-

cial construction (see paragraph 2.3.3): a strong role for reflection and conceptualization, a medium-to-low role for the use of experience, a strong role for knowledge acquisition and interpretation, and a low role for knowledge distribution and application. In the crystallization phase there are more elements that are characteristic of social construction (medium use of experience high-to-medium levels of knowledge distribution and application), but there are also elements that are not applicable with social construction (high-to-medium levels of reflection and conceptualization and high levels of knowledge acquisition and interpretation). The unsuccessful cases also show characteristics of social construction during the crystallization phase. The question thus can be asked: what is the predictive value of a social constructivist process on the success of the innovative process during the crystallization phase? In the evolution phase the successful cases show high-to-medium scores on the variables that are characteristic of social constructivist processes, whereas the unsuccessful cases show medium scores on these characteristics. As such, it can be stated that processes on the basis of social constructivism have no positive influence on the success of innovative processes in the phases of idea generation and crystallization but do have a positive influence in the evolution phase. We want to conclude on this basis that social constructivist learning processes are essential to incremental innovation processes (that take place in the evolution phase) but are not essential to the creation of radical innovations.

11. Management plays a leading role in the creation of radical innovations

- This proposition was not explicitly addressed. However, from the conclusion and the discussion of the other propositions it appears that:
- Senior management plays a conditional role in the idea generation phase in accepting gatekeepers to participate in external knowledge networks, to adopt a reflective and conceptual learning style in combination with an experimental learning style and a primary personal knowledge building focus rather than a problem solving goal orientation. This means that management has to permit less results-focussed and more explorative attitudes and behaviours from gatekeepers and has to create room for reflection and knowledge acquisition in the idea generation phase. This means loosening up on a results- and target-oriented culture during the idea generation phase.
- Senior management plays a more active role in the idea generation and crystallization phase in facilitating the introduction of new knowledge that lies outside the dominant frame of reference of the organization.
- Senior management plays an active role in the interpretation of this new knowledge within the boundaries of the organization and the realization of agreement within the strategic circle (inside and/or outside the organization). As such senior management may play a leading role in:
 - sponsoring the gatekeeper and his or her basic ideas
 - creating a strategic platform that caters to the incorporation of these ideas into the organization
 - The facilitation of creation of and agreement on subsequent core concepts.
- There may also be a conditional or more active role for senior management in influencing decision making and acceptance processes related to the implementation of the innovation in the evolution phase. This last point, however, appears less clear cut from the results.

9. TOWARDS A PROCESS DESIGN MODEL FOR RADICAL INNOVATIONS

The aim of this study is to develop a design model that provides a design for the process of creation of radical innovations for KISFs and that is tested and validated by empirical research. This model should contribute to the overall goal of the creation of radical innovations, which involves:

- The creation and use of innovations that realize strategic competitiveness for KISFs
- The creation of radical innovations
- The implementation and application of radical innovations
- The development of processes that lead to the creation, implementation and application of radical innovations
- The utilization of the process design model in a way that leads to successful creation, implementation and application of radical innovations.

In this chapter we start with setting the conditions for the creation and use of the process design model. We continue with the development of practical design components that constitute elements of our model. The practical design components are developed on the basis of the conceptual model from the first part of our study, from the findings of the empirical research, from conclusions on the conceptual model and additional background literature. We end by presenting our process design model and a summation of the practical design components.

9.1 CONDITIONS

In part 1 of this study the theoretical underpinnings have been explored, which led to the development of the conceptual framework and accompanying propositions. These have been tested and revised on the basis of two sets of cases studies. Now the components for the process design model are available. They are presented in such a way that they provide for an application of this model in a real life situation. The need for such a presentation indicates some important conditions for setting up process design models for radical innovations in KISFs:

- The (revised) theoretical foundations have to be translated into practical design components without impeding these underlying theoretical foundations.
- The practical design components are based on theoretical foundations and on testing of these foundations in empirical case studies. The character both of the radical innovative process and of KISFs is such that the practical design components are heuristic rather than algorithmic and prescriptive.
- The practical design components have the form of heuristics and are propositions for an approach to the process of designing radical innovations in KISFs for change-agents, managers and consultants in these processes.
- The propositions are aimed at providing a wide range of possible actions for these change-agents, managers and consultants.
- The propositions are formulated as guidelines that may be used in order to develop a process that leads to the creation of radical innovations in KISFs.

- The range of possible actions has a larger degree of external validity when there is more similarity between the field situation and the characteristics of the case studies in this research project. This means that the choice of our case studies in the first and second part of our research project may restrict the area of application for our process design model.

9.2 DEVELOPING PRACTICAL DESIGN COMPONENTS

In this paragraph we attempt to develop practical design components that may help the process of creating radical innovations in KISFs. The design components are formulated as guidelines that can be used to design and operationalize the process of creating radical innovations. We develop these guidelines on the basis of the theoretical framework, on our cross-case analysis of the four case studies in part one, the conclusions we drew from the cross case analysis, and on an additional discussion of background literature. The discussion is presented in such a way that it leads towards the deduction of practical design components for ‘a process design model for radical innovations in KISFs’.

9.2.1 The innovative process

Our research findings are in line with both the literature on innovation in general (2.1.3) and the literature on explorative learning (2.3.2), which reveal how the innovative process leading to radical innovations in KISFs is a process that can be divided into different phases with different characteristics. These phases are a mixture of the different phasing models that are described in the context of innovation in production or in high technology firms and the phases described in the literature on explorative learning.

In terms of the literature on innovation in general there are parallels with the described ‘successive steps models’, consisting of R&D, decision making and dissemination and implementation, evaluation and correction (Vracking and Cozijnsen, 1992; von Krogh et al, 2000) and the ‘paradigm shift model’, consisting of periods of technological uncertainty and discontinuity, technological ferment, appearance of new dominant designs with power struggles followed by periods of incremental change (Tushman and Rosenkopf, 1992). In terms of the literature on explorative learning there are parallels with the analysis of high impact learning processes (Ulrich et al., 1993). Whereas the paradigm shift model stresses the socio-political struggle of the radical innovative process, the high impact learning model stresses the learning processes and information contents of the innovative process (discovering and acquiring ideas or concepts, selection and application of ideas and generalization, integration and application). The successive steps model is characteristic of the overall proceedings of the total process, whereas the paradigm shift model and the high impact learning model are more characteristic of the actual process in terms of interaction and content during the different phases of the radical innovative process in KISFs. In line with the literature on both innovation in general and high impact learning, we discern in our research three stages in the innovative process (see also section 6.3):

- the idea generation phase
- the crystallization phase
- the evolution phase.

In addition to the literature on the phases in innovation, the findings in our research show that although these three phases are in general successive, they are not strictly demarcated. In the innovative process there is a certain degree of interaction between the phases, leading the innovative process to higher and more complete levels. As such the phases can be defined more in terms of characteristic process than in terms of fixed time slots.

Our research findings show that the process of radical innovations in KISFs is more in line with the description of general radical (paradigm shift) innovative processes in manufacturing and high technology firms than with the description of radical innovation in KISFs reflected in the total sum of a continuum of incremental innovative processes (Robinson and Stern, 1997; Coombs, 1999, see also 2.1.5). When we translate this finding to the literature on learning processes, we find that although elements of Kolbs model for experiential learning (1984) have significance for learning in radical innovative processes, the cyclical character of the model is not representative of the process of radical innovation in KISFs.

On the basis of the above discussion we want to define our first practical design component:

1. *For the creation of radical innovations in KISFs it is necessary to design a process that is based on the proceedings of design activities through three phases:*

- a. *An idea generation phase*
- b. *A crystallization phase*
- c. *An evolution phase*

These phases have to be designed in such a way that they are in general successive, but essentially conditional in sequence. The progression through a phase is hampered if the former phase has not been successfully completed. There is some overlap and interaction between the phases (leading to completion at higher and more appropriate levels).

As stated in the discussion leading to our first practical design component, we defined the contents of the phases in terms of a socio-political process and in terms of learning processes and information contents. This is in line with the discussion of the theoretical framework and the conclusions on the basis of our four case studies, where we stressed the proceedings in the innovative process as a combination of:

- Learning processes that show parallels with the processes of high impact learning (Ulrich et al., 1993) in combination with elements of the experiential learning processes as defined by Kolb (1984) and remodelled by Dixon (1994).
- Information processing activities that reside in autonomous strategic behaviour, in which technology strategies have a tendency towards external technology sourcing (Burgelman, 1983) and information processing activities that are based on growth knowledge management strategies (see our discussion in section 2.2.2 and 2.2.3).
- Socio-political processes that manage the power struggles between management and professionals, and within groups of professionals (Reed, 1996), where these power struggles arise as a consequence of lack of identification with innovative activities that are based on knowledge imported from outside (Wenger, 1998; Eisenhardt and Santos, 1995; Van Poucke and van Wijk, 1995).

This 'three dimensional approach' is confirmed by our cross site cross case analysis that shows a significant role for learning processes, information processing activities and socio-political processes in the innovative process and shows a detrimental effect on the innovative process when the result of one of the three processes is negative. All three processes have to be consciously managed separately and in interaction. This leads to our second and third practical design components:

2. *The process of radical innovation has to be designed in such a way that it results from the outcomes of three underlying processes that constitute the innovative process:*
 - a. *Learning processes*
 - b. *Information processing*
 - c. *Socio-political processes.**These processes are interrelated and have to be designed and managed in an interdependent mode.*

3. *Successful innovative processes have to be steered not only in terms of content output but also in terms of process output.*

9.2.2 Idea generation phase

As stated in the conclusion of our four case studies, the most crucial element of this phase is the importation of new knowledge and the processing (interpretation) of this information in the organization by reflection and conceptualization within the context of the required change. In effect this phase mirrors the R&D phase in innovation in non-service firms, but differs from these R&D-processes to the extent that:

- there is no physical R&D-department that has, as its core activity, knowledge sourcing, reflection and conceptualization, experimentation and interpretation in terms of the goals of organization.
- it seems that more often than not R&D in KISFs is not a deliberate and managerial steered process that resides within a recognizable group in the organization, but is a individual project of one member of the organization. This individual acts on his or her own initiative, thereby stimulating the formation of new individual mental maps. In general this individual will lack the position and capacity to realize the importation and collective integration of this new knowledge into the organization. (see section 6.3 and 6.3.1).

The individual who performs the act of acquisition and is the first interpreter of knowledge can be defined as a gatekeeper, who has often multi membership in both the organization and relevant knowledge networks (Dodgson, 1993; Leonard- Barton, 1995), but who often has also a peripheral position in the organization as a consequence of his or her multi membership (Wenger, 1998).

This leads us to the first practical design component for the idea generation phase:

4. *The focus of the idea generation phase has to lie in information processing activities. These information processing activities have to be aimed towards the acquisi-*

tion of new knowledge from external networks, importation of this new knowledge into the organization and (preliminary) interpretation of this knowledge in the context of the innovative issue (the issue demanding innovation). These information processing activities are in general performed by single persons who can be defined as gate keepers.

Our findings show that the idea generation phase is characterised by an experimental learning style combined with a boundary spanning style. This boundary spanning learning style allows the gatekeeper to move out of the boundaries of information processing activities within the dominant frame of reference of the organisation. The gatekeeper moves out of activities within the context of epistemology of practice (Cook and Brown, 1999) and into the spheres that cross organizational and technological borders (Rosenkopf and Nerkar, 1999) in order to acquire new knowledge across organizational and technological boundaries. The boundary spanning learning style is combined with an experimental learning style in order to combine the process of knowledge acquisition with interpretation (combination, synthesis). In this context reflection and conceptualization take place. The essential double loop learning character of this phase and the move into a new frame of reference may be illustrated by the fact that we found in our cases that in the idea generation phase learning is defined more by reflection and conceptualization than by learning based in actual experiences.

In this process the gatekeeper is motivated by a personal knowledge-building goal orientation leading to the generation of new questions and problems and aiming towards new solutions and answers. A secondary goal orientation of problem solution may help in keeping personal knowledge building focused on the issue at hand (rather than aiming towards personal knowledge building as a goal in itself). On the basis of this we want to define as a practical design component:

5. *In the idea generation phase learning styles have to be applied that are supportive of the information processing activities:*
 - a. *Boundary spanning learning styles supportive of knowledge acquisition and importation*
 - b. *Experimental learning styles supportive of knowledge interpretation*
 - c. *A dominant goal orientation aimed at personal knowledge building in order to stimulate knowledge acquisition and interpretation*
 - d. *A secondary goal orientation aimed at problem solving in order to keep the acquisition and interpretation of knowledge within the boundaries of the innovative issue*

There are two strong characteristics in the idea generation phase that may inhibit its gains for the total innovative process:

- As March (1991) states the returns of explorative learning styles are often uncertain, distant and negative. This means that the gatekeeper has to fight for room and recognition of this activities without being able to prove the profit of his activities for the organization.
- Radical innovation cannot be an individual process as its effects will have to be implemented by the collective of professionals who work in the organization (Stewart, 1997, Coombs, 1999). As the idea generation phase is strongly individually bound and the

gatekeeper often has a peripheral position there is the danger of loss of developed innovative content as the other professionals lack identity of participation in the imported knowledge (Wenger, 1998). This means that at some stage in the idea generation phase the newly developed individual mental model has to be transformed into a (preliminary) shared mental model (Kim, 1993) that is shared by gatekeepers and boundary spanners.

In these processes both management and professionals with a senior position have a role in the social political aspects of the innovative process, since they have enough status to cater to the importation and accommodation of new knowledge. This leads to the following practical design component for the idea generation phase:

6. *Both top management and senior professionals have to use their central role in the management of socio-political processes. These socio-political processes have to be geared towards:*
 - a. *Use of strategic recognition capacity for selection of valuable information processing activities and identification of prime gate keepers.*
 - b. *Creation of room and time for knowledge acquisition and interpretation activities by gate-keeper(s) without demands for immediate returns.*
 - c. *Support of the importation of acquired (and interpreted) knowledge into the organization (facilitation of primary absorptive capacity by other decision makers and opinion leaders).*

As we stated in 9.2.1 the phases in the innovation process have to be completed before a mature move towards the next phase can be made. In this light it is important to monitor whether the phase has been successfully completed. This means realization of the desired output in terms of contents and in terms of process. On the basis of the above description of the idea generation phase, we want to define the output of the idea generation phase as:

7. *The output of a successful idea generation phase can be defined as:*
 - a. *Contents: basic ideas for the radical innovation (outlines for new frames of reference).*
 - b. *Process: open connections between relevant external networks and the organization and acceptance of gatekeepers functioning as nodes.*

9.2.3 Crystallization phase

It appears from our findings that in the crystallization phase activities are aimed towards the transition of both acquired and imported knowledge into a clear basis for the actual innovation and towards the process of transforming the individual mental map into collective and shared mental maps that form the basis for the actual innovations. As we cited in our theoretical framework '*learning without change occurs when individuals generate new ideas, but individual ideas are not generalized into organizational systems ... in this sense innovation is not only the accomplishment of an [individual] initiative, but also the leverage of this accomplishment across the boundaries [of the organization]*' (Ulrich et al., pp. 60). As such we see the crystallization phase as an essential moment in transforming the innovative process from the isolated activities of one peripheral member to a collective innovative process that takes place at the core of the organization. Due to the power struggles that arise in KISFs on the basis of the social structure

that is inherent in organizations of professionals, when new knowledge is imported, this moment of transformation from the individual to the collective level is essential for the success of radical innovation in KISFs. Wenger (1998) defined two types of connections to the outside world: boundary objects (reified forms) and brokering (connections provided by people). In the general literature on innovation, boundary objects play a central role in the innovative process. This role relies on the content aspects, as it promotes understanding of translation efforts (Star and Griesemer, 1989) and serves as a basis for problem solving (Leonard-Barton, 1995). But it also relies on its capacity to '*facilitate the multiple transactions needed to engineer agreements among multiple social worlds*' (Star and Griesemer, 1989, pp.). On the bases of our findings we want to state that in KISFs especially this ability to facilitate multiple transactions relies not only on boundary objects. It is the management of the socio-political negotiation processes that arise from changes in the dominant paradigm (Reed, 1996) that is crucial for the actual ability to facilitate transactions and the creation of collective frames of reference. These negotiation processes are only partly influenced by boundary objects and are for the majority influenced by differences in position and status between management and professionals and among professionals themselves. This leads to our central practical design component for the crystallization phase:

8. *The focus of the crystallization phase should be aimed towards information processing activities and socio-political processes. The information processing activities have to be mainly aimed towards knowledge interpretation in the light of the creation of a core concept for the innovation. The socio-political processes have to be aimed at the acceptance of the core concept within the organization and the start of reframing experiences in the organization within the new frame of reference.*

Our findings show that the crystallization phase is defined by a learning style that is a combination of boundary spanning and experimental learning. Although this parallels the learning styles in the idea generation phase, it aims at different processes and consequently there are differences. The use of boundary spanning activities are not so much aimed at gaining access to and intensive exploitation of the external knowledge network, but are aimed towards importation of knowledge by the gatekeeper to the internal boundary spanners in the organization. There is an accent on experimental learning as this is focused on interpreting imported knowledge and experimenting with this knowledge in order to develop a basis for the innovation. The process of experimentation with concepts is a wide process that sparks double loop learning at the collective level and is therefore based on a personal knowledge-building orientation but is at the same time focussed on production of new approaches for the innovative issues at hand. The learning process and information processing activities are partly a duplication of the process that has been undertaken by the gatekeeper. This is needed to realize internalization of the knowledge creation processes performed by the gatekeeper. In essence, the duplication processes can be considered as processes geared towards the enhancement of absorptive capacity that are essential for overcoming search-transfer problems (Hansen, 1999) and for the ability to exploit imported knowledge (Cohen and Levinthal, 1990). The process, however, is not only a duplication but reaches further; as a result of experimentation and negotiation processes a core concept is chosen. In this aspect there is more equivalence between personal knowledge building and problem solving goal orientations. The described processes can be translated into the following practical design component:

9. *In the crystallization phase applied learning styles in the organization have to be supportive of the information processing activities related to importation and interpretation:*
 - a. *Boundary spanning learning styles supportive of importation of acquired knowledge.*
 - b. *Experimental learning styles supportive of knowledge interpretation in the light of concept creation.*
 - c. *A goal orientation aimed at personal knowledge building in order to stimulate knowledge interpretation and concept creation.*
 - d. *A goal orientation aimed at problem solving in order to interpret knowledge in the context of the innovative issue and to create a core concept for the issue at hand.*

As stated the findings and induction from the theoretical framework show that socio-political processes play a central role in the crystallization phase. In terms of the effects of the socio-political process, the focus shifts from supporting imagination processes towards realizing alignment processes. Since the support of imagination processes asks partly for a duplication of the information processing activities performed by the gatekeeper, there is a need for open relations among groups and within the group of boundary spanners. However, as in the process of experimentation, the core concept is created and the socio-political processes close down as the aim shifts from imagination to alignment. This asks for a closing down of socio-political processes once the core concept has been identified and for information processing aimed towards the distribution of the core concept and alignment of the organization in terms of interpretation of experiences within the context of the new frame of reference.

The success of the process of imagination is, as stated, strongly influenced by negotiation processes that take place. These processes influence the willingness by core professionals to accept the importation and use of new knowledge from outside. These negotiation processes are strongly determined by differences in position and status between advocates of the innovative process and those professionals who serve as opinion leaders. As a consequence of the usually peripheral position of the gatekeeper, the gatekeeper by himself will not in general be able to complete these negotiation processes with a positive result. Therefore, for successful innovation, it is deemed necessary for the gatekeeper to be surrounded by one or a number of boundary spanners who are supporters of the innovation, but who also have a core position in the internal network. In general it seems that collective brokering with more boundary spanners gives a higher chance of success. If there are multiple links between the gatekeeper and the organization, synergy may be created between the boundary spanners (the creation of the reified core concept is the product of negotiation on imported and interpreted knowledge by the group of boundary spanners), and the collective of boundary spanners has more weight in terms of status and influential power. In our cases we found not only that management performs the function of boundary spanners, but that boundary spanners, precisely in KISFs, where professionals have a central role, should be recruited from the body of professionals. In one of our cases we found the detrimental effect of boundary spanners with strong conflicts of interests. It appears that although there may be some difference of opinion within the group of boundary spanners, there seems to be a need for a general alignment within this group.

We also found in two cases that in situations where external actors decide on the actual implementation and use of the innovation (clients or stakeholders), boundary spanners should also be recruited from this group. For an external group of stakeholders the same remarks apply that we made on the internal group of stakeholders.

On the basis of the above remarks we define the following process design components:

10. *Create socio-political processes that are characterized by:*
 - a. *A significant role for both gatekeeper and boundary spanners, the latter consisting of a group of decision makers and opinion leaders with core position in the organization (or the relevant network of decision makers). The selection of the group of boundary spanners is a crucial aspect of the proceedings in the crystallization phase. Boundary spanners have to provide for both a core position in the organization and an open attitude towards innovation. Collective brokering might help in this process when multiple links between the gatekeeper and the organization are created but may be detrimental where there are strong conflicts of interests between the different boundary spanners.*
 - b. *Open relations between the gatekeeper and the boundary spanners, with a role for the gatekeeper in bringing the information to the organization and a role for the boundary spanners in actual importation of knowledge into the organization and interpretation of the organization in the light of an approach towards the innovative issue (enhancing absorptive capacity and creation of the core concept).*
 - c. *Closing down of the social process after the core concept is created in order to enhance alignment in the organization on the reified core concept and chosen frame of reference.*

On the basis of the above description of the crystallization phase, we want to define the following elements as the output for the crystallization phase:

11. *The output of a successful crystallization phase can be defined as:*
 - a. *Contents: a reified core concept as the basis for the actual innovation.*
 - b. *Process: stage one: enhancement of absorptive capacity, stage two: alignment on the chosen frame of reference.*
 - c. *The reified core concept has to form a clear and illustrative frame of reference but has to be stated at a level of abstraction that leaves room for the actual interpretation and realization of the innovation by the professional in the process of service provision.*

9.2.4 Evolution phase

It appears from our findings that activities in the evolution phase are in the first instance mainly directed towards the development of actual artefacts, processes or routines that form the essence of the innovation, and in second instance at further refinement and improvement of the innovation. In general literature this is referred to as implementation, evaluation and correction (successive steps model) or the period of incremental change that follows the appearance of a domi-

nant design (paradigm shift model). On the basis of our findings we concluded that in successful innovations the evolution phase shows a clear resemblance towards learning processes as defined in our approach to social constructivism. On both the basis of our findings and the theoretical framework, we conclude that positive results in the evolution phase do not rely heavily on socio-political processes. The power struggles that arise from changing the dominant frame of reference (Reed, 1996, Tushman and Rosenkopf, 1992) are settled in the crystallization phase. The main process in the evolution phase is aimed towards materializing the innovation by interpreting operational experience in the new frame of reference, developing materialized innovations and realizing further improvements. In line with the accents in social constructivism (Daft and Weick, 1984, Brown and Duguid, 1991) there is a strong accent on learning, knowledge processing and interaction processes. This leads to the following two process design component:

12. *In the evolution phase the emphasis has to be on learning activities and information processing activities. There is no strong role for socio-political processes.*
13. *Interactive processes have to occur mainly within groups, and have to be aimed at knowledge exchange within the chosen frame of reference, thereby stimulating continuous incremental innovation.*

As stated in the discussion of the first two cases, the absorptive capacity that is created in the crystallization phase continues to be used in this phase to exploit the new knowledge and new frame of reference. In the first stages of the evolution phase, there is an emphasis on distributing the frame of reference and distributing new interpretations of operational experience within the context of this frame of reference. This will lead to the development of innovative artefacts and activities as experiences and insights are placed in this new frame of reference and as the results are applied to the work environment and the demands of the primary process (Leonard-Barton, 1995; Coombs, 1999):

14. *Information processing activities have to be geared towards:*
 - a. *Knowledge distribution of the reified core concept as a new frame of reference for the activities in the organization and for plans that are derived from this core concept.*
 - b. *Knowledge application as experiences and insights are placed in the new frame of reference and translated into innovative activities.*

Learning styles are in line with the style described in social constructivism. There is a strong accent on processing of experience, but (unlike social constructivism) these experiences are now processed within the new frame of reference. Learning styles are a combination of boundary spanning and continuous improvement. Both experiences from the actor himself and relevant others (inside and outside the organization) are used to shape the innovative activities, and, in a later stage, to improve the innovative activities. From the successful cases it became clear that even during later improvements, the created core concept was still used as a touchstone. When the organization is actually able to turn this process of creation and improvement into a continuous process, a continuous (incremental) innovative ability is created (we want to point out that the continuous incremental innovative ability is not equal to continuous radical innovative ability, we will elaborate on this in the final discussion). For the incremental innovative ability there is a need for a problem solving goal orientation. In practice we found that there was also a task

oriented goal orientation as professionals may see it as their task to realize incremental improvements. This leads us to the following process design component:

15. *Applied learning styles have to be created that focus on:*
 - a. *Processing of experiences, whereby these experiences (both in the pre-innovation and post-innovation situation) are placed inside the new frame of reference and are translated into innovative activities (both initial innovation and continuous innovation).*
 - b. *A combination of boundary spanning and continuous innovation, in which experiences from others are used to shape the innovative process in terms of further improvement and re-invention.*
 - c. *A problem solving and task oriented goal orientation that is aimed towards solution of practical problems arising from the process of implementation and application of the innovative activities.*

This leads to the following conclusion on the evolution phase:

16. *The output of a successful realization phase can be defined as:*
 - a. *Contents: implemented innovative activities.*
 - b. *Process: processes of continuous incremental improvement.*

10. CASE STUDY PHARMACY: PROCEEDINGS AND RESULTS

In this chapter we present the proceedings of and results from the case study Pharmacy. The first paragraph deals with a number of methodological considerations; the second paragraph gives the description of the case Pharmacy, highlighting the headlines of the innovation and innovation process that took place. The focus of the third part of this chapter (paragraph 10.3) is on the results of case Pharmacy. The results of the case study are presented on the base of condensed within-site displays for the case. These displays are based on information from the interviews, relevant documents and physical artefacts.

10.1 PROCEEDINGS

The case study Pharmacy may be considered as a single case study with multiple units of analysis. This empirical case study is a replication of the four first case studies as well as an evaluation study of the application of the process design model for radical innovations. In that line, the same propositions apply to this study that applied to our four first case studies. In order to conduct the evaluation of the process design model, an additional proposition is stated:

Adequate application of the process design model for radical innovation will generate better results in radical innovation than the results from the unsuccessful cases.

10.1.1 Variables

As this case study is based on the same propositions, variables and their constituting elements as the four first case studies, the same description for the variables given in chapter four, hold for this part of the study. For the additional propositions we define the variable adequate application of the process design model in line with the practical design components as stated in chapter 9. This definition is summarized in table 10.1 (shaded cells are key elements in the process design model).

Phase	Idea generation	Crystallization	Incremental innovation
Learning Processes	Reflection and conceptualization Boundary spanning Experimental learning style Personal knowledge building in the context of the issue	Boundary spanning/ experimental style geared towards concept creation Personal knowledge building and problem solving aimed towards concept creation	Processing of experiences Boundary spanning and continuous improvement Problem solving and task oriented learning style
Information processes	Acquisition of knowledge from external networks Interpretation of external knowledge in the context of the innovative issue	Knowledge interpretation Creation of a core concept	Distribution of the core concept Knowledge application: placing experiences and insights in the new frame of reference and developing innovations
Political Processes	Identification of gate keepers Room and time for knowledge acquisition and interpretation (open connections) Facilitation of primary absorptive capacity	Identification of boundary spanners Stimulation of boundary spanners to import knowledge and interpret knowledge in order to create a core concept (enhancing absorptive capacity) Creation of alignment on the core concept and creation of a new frame of reference	Interactive processes within the frame of reference

10.1.2 Data collection and data analysis

Data collection

Data collection is performed in the same way as it is in part 1. There are, however, two main differences:

- **Variable ‘adequate application of the process design model’:** the data related to this variable are collected by asking extra questions regarding this issue in the interviews and by assessing documents and proceedings of meetings in relation to this variable. The assessment is performed by an independent assessor (see the next point).
- **Researcher and assessor:** As the researcher of this study also acted as the project and process manager in the case Pharmacy (and is thus partly responsible for the application of the process design model), the decision is made to assign an independent researcher for part two of this research project. All data-collection and analysis is performed by this independent researcher.

The questionnaire used for data collection is included in appendix VIII.

Data analysis

Data analysis for part 2 of this study is performed in the same way as for part 1.

10.2 CASE DESCRIPTION PHARMACY: CURRICULUM RENEWAL

The Faculty of Pharmaceutical Sciences, part of the University Utrecht, is one of two scientific institutes in the Netherlands that educates students for the profession of pharmacist. It offers a bachelor and a master degree, which both take three years. The master phase has a differentiation between the curriculum for pharmacist and for researcher. The organization is built up around six departments that cover all the areas of the pharmaceutical sciences, from a product-orientation on one side to a patient-orientation on the other. The organization is divided into an educational department and a research department. The board of the faculty consists of the dean, the director, the director of education and the research director.

Recently a curriculum renewal for the total educational program was realized in the Faculty of Pharmaceutical Sciences.

In the late 1990's the Faculty of Pharmaceutical Sciences was trying to change the curriculum, in answer to bad reports from the visitation committee in 1995. The way of dealing with the bad results was to use a 'cheese slicer' method, cutting off small parts of each department, i.e. changing incrementally. This way of dealing with the change in the curriculum was not very effective. As a result, the visitation in 2000 was even worse and the curriculum had to change drastically. This was accomplished through a recent curriculum renewal, taking place between 2000 and 2003.

Causes for change

The causes for the radical change were partly instilled from outside and partly from inside:

- The negative results in the report from the visitation committee: The attempts to renew the curriculum after 1995 did not work out; as a consequence the recent visitation in 2000 was even worse. No other option was possible than changing the curriculum thoroughly.
- A change in the professional tasks of pharmacists: a shift can be observed from a product-orientation to a patient-orientation. This requires new and different content and skills, which have to be included in the curriculum. This asks for a change from knowledge orientation towards competence orientation as the profession of pharmacist moves from knowledge possession towards the competence of learning, acquiring knowledge and acting in the field of pharmaceutical sciences.
- A change in educational methods: new insights in education show the appearance of new educational methods that are more effective for the learning process than the existing, more traditional, methods. The educational director and a small group of professionals deemed it necessary to incorporate new educational methods into the new curriculum.
- Bachelor-master structure: due to the treaty of Bologna in 1999, a split is necessary in the set-up of the curriculum in a bachelor and a master phase.

Innovation process

Due to these reasons it is decided by the educational director and the dean that the curriculum has to change fundamentally. Several steps are taken to accomplish a change from the old situation. The first step in the process is the formal decision to change the curriculum and to configure a project team. This decision is made by the educational director and the dean and formalized by the University Board.

Second is the formation of a project group, the curriculum committee (the CURC). This project group consists mostly of people from within the faculty. They are senior professionals mainly at the level of lecturer and assistant professor. It is not possible to recruit (senior) professors, as they indicate that, due to various reasons, they either do not want to or are not able to take a seat in the CURC. There are also some outsiders that are members of the CURC: an external process manager leading the group and people from the IVLOS (an educational consultancy group that is part of the University Utrecht) for additional expertise on the educational field. A conscious choice is made to have an external process manager leading this committee. The CURC is responsible for the process leading to a new curriculum and is responsible for advising the education director about the creation and implementation of the curriculum renewal.

Next step is the start of the development of a first concept of the new curriculum. The project team designs the new curriculum, more or the less, from scratch: all elements are points of consideration. To develop a first concept, the following steps are taken:

- a thorough discussion with the different national professional associations in order to determine the professional qualifications and as such the end goals for the program (both for the bachelor and the master program)
- the development of an elaborate vision on the educational principles for the new program
- a positioning of the curriculum within the bachelor-master structure of the university
- development of an outline for the new curriculum ('blocks', place of blocks in the program and outlines for the contents of the blocks).

These aspects are written down in the 'Blueprint', which is used as a framework for the curriculum renewal. After the members of the organization are informed about the Blueprint, and formal decision making takes place by the faculty board and advisory committees, teams are configured to develop the Blueprint in more detailed proposals for the curriculum. This is done by block development teams (BOTs). BOTs are chaired by senior staff, mostly professors responsible for a knowledge field in or related to pharmacy. In each BOT a member of the CURC participates and a consultant from the IVLOS is assigned as an educational consultant. Task of the BOTs is to work out a detailed program for the assigned block, resulting in a final block book. As a basis the BOT is given a document drafted by the CURC with guidelines about goals, contents and preferred educational methods for the block. During the process of elaborating the blocks the BOTs report to the CURC (this is done by three formal sessions in which plans from the BOTs are discussed by the CURC and BOT together, leading to advice from the CURC for ameliorations in the blocks). Formal decisions about block proposals are made by the director of education advised by, amongst others, an advisory committee consisting of senior staff members who are responsible for education in their department (none of these staff members participates in the CURC). In this process the formal position of the CURC is not totally clear (is it an advi-

sory committee to the board, or does it have the power to decide on approval or rejection of proposals from the BOTs).

The next step in the processes is the execution and implementation of the new curriculum by block execution teams (BUTs). The BUTs do this on the basis of the block books developed by the BOTs. There is some, but not total, overlap in staffing between BOTs and BUTs.

The last step in the process is the block evaluations, starting after the first blocks of year 1 and 3 are implemented. A more fundamental evaluation takes place after the first year is implemented. This serves as a base to further develop and improve the concept lying behind the curriculum as well as thinking in advance of possible hazards for the following years.

The implementation of the new curriculum is realized in three years. It is a phased implementation of the curriculum in which two years (respectively a year from the bachelors' program and a year from the masters' program) at a time are implemented.

Changes in the curriculum

Major differences in the characteristics of the curriculum between the old and the current situation are: a change from teacher oriented to student activating educational methods, a change from 'total packages' of knowledge fields to concentric formation of knowledge (base in year 1, elaborations in year 2 etc.), creation of integrated blocks: from mono- to multi-disciplinary, a change from a knowledge- to a competency-orientation and an increased orientation on the profession of pharmacy rather than on the pure scientific field of pharmacy.

Organizational structure and culture

As a consequence of the curriculum renewal there are major changes created in the organizational structure. There is a shift of the direct responsibility for the educational programme from the departments (bottom-up) to the faculty board and educationmanagement team (top-down). This shift is reflected in the integration and direction of the whole organization. Integration is realized both by the creation of new integrating functions, integrating committees and meetings on education for all staff members.

At the end of the innovation process the process of continuous improvement is integrated in the structure and processes of the organization. This is realized by continuous evaluation and subsequent improvement, by interdisciplinary meetings on program improvement and by appointing managers and coordinators for the different parts of the curriculum (both phase managers and block-chairman) who are constantly held responsible for the quality and development of the curriculum. In general there is a shift to more top-down steering of the educational program and involved staff members.

Major hick-ups in the process

In the process there are two major hick-ups:

- a. After 1 year of development of blocks and just before the implementation of the first year there is major opposition from a number of senior professors. They have a number of objections towards both the innovative process and the contents of the new curriculum:

- In terms of process there is a general feeling that the CURC, consisting of employees lower in rank and position, have taken over the power on the curriculum. Professors feel they have to 'obey to the commands from the CURC'.
- In terms of contents a number of professors (but not the majority!) feel that important parts of contents are being left out; this is directly related to the shift in contents from product-oriented towards patient-oriented.
- In terms of content some professors object to concentric and integrated programming: in their view some knowledge fields have to be presented in a fundamental way and 'all-in-one', rather than in more applied approaches, integrated with other fields and dispersed over several years. As such they protest the new underlying educational principles.

In reaction to this several steps are taken:

- A group of professors (opinion leaders with a role in education and principally with positive and neutral views on renewals in education) meets several times with management and a leading group from the CURC to discuss the contents of the new curriculum (this is done at intermittent times during the rest of the innovative process). The views created in this group (that do not differ a lot from the proposals from the CURC) are taken over as leading the curriculum. This concerns both the contents of the program and the underlying educational principles. Together a more concise and agreed upon concept of the new curriculum is developed.
- An attempt is made to include a professor in the CURC; this attempt fails as the professor hardly ever shows up for meetings.

At the same time the faculty is appointed an award from the most important professional association on their plans for innovation of the curriculum. The appointment of this prize is widely published and celebrated in the faculty. The vice-chancellor of the University is invited to give a speech on the accomplishments of the faculty.

- b. During the first year of implementation of the new curriculum (while four other years are being developed), there are major protests against the chosen educational methods. Both the CURC, who has a leading role in designing the chosen methods and the IVLOS, which operated as a consultant in this process were seen as too dominant in prescribing the way professionals work. As a reaction to this the following steps are undertaken:
- Prescriptions for educational methods and the way professionals have to perform on this are loosened up.
 - Instead of detailed educational principles a broader concept for the new curriculum is used: CIA (concentric, integrated, activating). BOTs are given the freedom to develop educational methods that fit in with this new concept. Proposals from the BOTs are tested in terms of the new concept.
 - Small learning communities are being set up in the faculty; staff members who are successful in applying the new educational methods play a role in advising BOTs and BUTs that are either not successful in applying the educational methods or who still have to develop new educational methods. In these communities new insights and methods are discussed and exchanged.

- The role of the IVLOS is reduced from consultancy in designing and prescribing new methods to providing training in how to use new methods. There is a change in the IVLOS-consultants from 'innovating actors' to 'trainers and coaches'.

Results

Several results are realized in the innovative process:

- There was a more than positive evaluation from the educational inspection on the innovative process and the resulting new curriculum.
- There was a 60% increase in students with a decrease in pharmacy students at the national level (this may also have been caused by improved information to potential students from secondary education).
- The new curriculum was awarded the innovation prize by the KNMP (Dutch Royal Association of Pharmacists).
- The curriculum changes are used by the University Utrecht as good practice for curriculum renewal, several elements are now considered as University policy.
- The organizational culture is more positive towards innovation, there is an increase in the willingness to change and a more motivated workforce can be noticed. There is a general learning effect through increased exchange of experiences.
- There is an improvement in the horizontal communication within the faculty.

10.3 WITHIN-SITE ANALYSIS CASE PHARMACY

A. Success and character of the innovation

The innovation can be considered as successful since there was a positive result on more than 3 out of the 5 criteria.

Case Pharmacy	Criteria	Description	Result
	<i>Possibility to implement</i>	The core concept is further developed, worked out and implemented.	Positive
	<i>Duration of life</i>	Due to a renewal exposed from outside, small changes will be made to the curriculum. However, the core concept and general outlines of the curriculum will still be in place.	Positive
	<i>Realization of goals</i>	Most important goals (set in the beginning) are realised, but due to resistance from the strategic circle not all goals are realised.	Positive
	<i>Considered a success by relevant others</i>	The innovation received positive reactions, of which some had a critical note, from several parties outside the faculty.	Positive
	<i>Realized pay-offs</i>	The realised pay-offs can be divided among the students, the curriculum and the organization. The first students of the new education programme will graduate as early as half way 2004; until then the pay off is unknown. Student numbers have risen 60%. The curriculum improved drastically, reflected by the innovation prize of the KNMP and a positive evaluation of the education inspection. The organization around the curriculum improved significantly, in which the best aspect is a better integration of the departments.	Positive

Display 10.1- Pharmacy I: Degree of success

The innovation is considered to be a radical innovation. 3 out of 4 criteria have a medium to positive score. The curriculum is considered to be radical by relevant actors, as in their eyes a paradigm shift has taken place.

Case Pharmacy	Criteria	Description	Result
	<i>Basis for developments</i>	The renewal of the curriculum has served as a start for new developments in the Faculty of Pharmacy. In other faculties in the pharmaceutical education it also forms a basis for developments. They are coming to Utrecht to see how it works there.	Positive
	<i>New insights in the professional community</i>	The innovation gains new insights in the education in pharmacy and the professional field. The curriculum is used as an example in the university. However, an increasing number of other fields in education were already familiar with this new configuration of the curriculum.	Medium positive
	<i>Generalization to the professional community</i>	A trend in curriculum changes in higher education can be spotted, using modern educational methods in the changed curriculum.	Medium
	<i>Status in the professional community</i>	The name of the Faculty of Pharmacy is not linked to this new concept. Additionally, the faculty needs to personalise this model to the standards needed in pharmaceutical education.	Medium to negative

Display 10.2- Pharmacy II: Character of the innovation

B. Adequate application of the process design model

Phase	Application of the process design model
Idea generation	<ul style="list-style-type: none"> ▪ Forming project team, consisting of: people from several departments, people from IVLOS, students, education director, education manager and an external process manager ▪ Consultation of external network, e.g. professional field and external education field about professionals and educational developments and views on form and content of the new curriculum ▪ Noticing developments, trends and emerging problems in the external fields and its relation to the faculty ▪ Posing ideas, approaches and first concepts in a Blueprint, done by the project team ▪ Gaining financial support from the University Board and consent on the Blueprint by the faculty board
Crystallization I	<ul style="list-style-type: none"> ▪ Involving the rest of the organization in the process by creation of BOTs ▪ Development of the guidelines in the blueprints and guidelines for the BOTs into detailed plans ▪ Importing external knowledge by giving the IVLOS a role in the BOTs ▪ Stress on problem solving and task accomplishment as block books have to be developed in a restricted time frame ▪ Putting boundary spanners in a role of guiding the execution of plans developed by the gatekeepers (some CURC-members) ▪ Creating more commitment in the board of the Faculty of Pharmacy
Evolution I	<ul style="list-style-type: none"> ▪ Transforming the guidelines (Blueprint) from the CURC and plans from the BOTs into actual educational activities ▪ Training in order to obtain competencies for the new curriculum ▪ Execution and implementation of the new curriculum
Crystallization II	<ul style="list-style-type: none"> ▪ Creating a group of boundary spanners (senior professors) ▪ Getting agreement about the core concept and the outlines of the program between gatekeepers and boundary spanners ▪ Developing a clear core concept (CIA); using this concept as a focal point for innovative activities
Evolution II	<ul style="list-style-type: none"> ▪ Developing plans on the basis of the core concept and the agreed upon outlines by BOTs (in some of which boundary spanners participate; in others members are linked to boundary spanners by the structure) ▪ Testing the development of plans on the basis of the core concept and the agreed upon outlines by CURC and BOTs; including boundary spanners in the results of these evaluations ▪ Visits of staff members to other universities where the same conceptual lines are used ▪ Discussion on experiences in the new program and development of improvements by executive professionals ▪ Installing a continuous evaluation and improvement system ▪ Installing a new structure with central positions for former gatekeepers and boundary spanners

Display 10.3- Pharmacy III: Phases and activities

Analysis of the different phases and activities demonstrates that:

- In the *idea generation phase* the focus is on developing basic ideas for the central elements of the new curriculum. This is done by gatekeepers from the CURC (one member and the IVLOS acting as a gatekeeper for educational development, other members acting as gatekeepers for the professional contents). Basic ideas and an initial concept for the new curriculum are developed and laid down in the Blueprint by the CURC. In order to develop these first basic ideas, the external network is consulted about educational methods and the content of the new curriculum. The IVLOS provided a lot of external knowledge about educational methods, as the institute has a lot of experience with curriculum renewals and modern educational methods in settings within and outside the university. Professional associations are consulted about what elements and competencies should be incorporated in the program. Both streams of input were extensively discussed in the CURC and in subgroups of the CURC to develop the Blueprint. The Blueprint was confirmed by the faculty board and the university board.
- The *crystallisation phase* is accomplished in two stages. In the first stage there is a lot of emphasis on the BOTs following the guidelines (prescriptions) from the CURC, this is partly due to the time pressure for the innovative process. BOTs have to accomplish a more or less imposed task, and are corrected when they do not accomplish this task adequately in the eyes of the CURC. Boundary spanners are positioned in the role as chairmen of the BOTs. They have influence in terms of filling in plans, but not in terms of determining contents and educational concepts. The chosen approach causes a revolt from the professors in the faculty, who threaten to abandon the whole process. This takes place as the third phase of realization and implementation has already started. As a reaction the crystallization phase is re-entered (with realization still continuing). In this second attempt towards crystallization, there is an emphasis on the influence of boundary spanners since they now have room to participate in determining the contents of the program. Their consent is also sought on the core concept for educational methods. The core concept is 'loosened up'; strict guidelines are replaced by a more abstract concept that accommodates a variety of methods. The boundary spanners are included in the process of evaluation and amelioration of plans. This leads to agreement on the outlines and core concepts for the new curriculum (for the majority of the senior staff).
- The *evolution phase* is divided in two parts that partly parallel the movements in the crystallization part. In the first stages of this phase, there is an emphasis on transforming guidelines into educational activities, this is done after some training takes place. After the revolt in the faculty and negative outcomes in one block, the guidelines for the BUTs are loosened up and replaced by the core concept and the plans from the BOTs. Both BOTs (that are active for the years that are still being developed) and BUTs are given more freedom to implement plans within the frame of the program outlines and core concept. The role of the IVLOS is changed from innovating capacity to coaching capacity. BUTs start to meet to exchange experiences and develop new educational methods. These experiences are also fed back to BOTs that are still in developing blocks.

In the idea generation phase the process design components are applied adequately. In the crystallization and evolution phases application of the components is not adequate the first time round. On the basis of emerging problems, the crystallization and evolution phase are 'revisited' and the process design components are applied adequately.

C. Actors and roles

The role of different circles, actors in these circles, and their roles can be summarized as depicted in the table below.

Case Pharmacy	Circles	Actors
Idea generation Result	▪ External → Strategic	▪ Gatekeepers ▪ Innovators ▪ Executing professionals
Crystallization Result	▪ External → Strategic	▪ Gatekeepers ▪ Boundary spanners ▪ Executing professionals
Evolution Result	▪ Strategic → Internal	▪ Boundary spanners ▪ Executing professionals

Display 10.4- Pharmacy IV: Actors and roles

In terms of the different circles that play a role in the innovation process the following can be stated:

- *External circle*: three external circles can be identified. First, the institutions from within the UU; the IVLOS, USP and University Board. These supplied support on several subjects. Second, the professional field which was consulted for the end terms of the new curriculum, e.g. KNMP, NIA and NVZA. Third, other universities both within and outside the Netherlands, i.e. respectively in Maastricht and in the USA, who provided knowledge about new educational insights. All three external circles played especially in the idea generation phase an important role, coming up with the initial basic ideas and setting up the first concept for a new curriculum. The role of gatekeepers was played by around 2 persons. One performing as a gatekeeper for education: this actor has just finished an external course for 'excellent teaching in university' focusing on new educational methods and insights, and where different universities abroad with excellent educational reputation were visited. The other (prime) gatekeeper is both a university teacher and is the owner of a large pharmacy. As such he plays a role in national associations.
- *Strategic circle*: several strategic circles act as such. Although external, the University Board played an important role in the idea generation phase, providing consent for the changes and the necessary support in the form of extra money. Within the Faculty of Pharmacy there are two important circles, the dean in combination with the director of education and the senior staff consisting of professors. The dean and director of education are formally responsible for policy and decision making. The professors in the faculty play a significant role in providing (or not) for the necessary commitment and political foundation in accomplishing the changes. The professors (or at least a number of them) can be considered as boundary spanners in the innovation process. Both dean and director and professors play an important role in the idea generation and crystallisation phase.
- *Internal circle*: the internal circle consists in the idea generation phase of the project team. The number of people internally involved increases during the innovation process,

involving the BOTs in the crystallisation phase and the BUTs in the evolution phase. Nearly all members of the faculty are involved in the innovation process.

Several actors play a role in the innovation process, both within and outside the organization. There are differences in the roles of the different actors according to the phase of the innovation process.

Characteristics of the idea generation phase:

- The external and strategic circle play an important role in the first phase of the innovation process. The external circle plays a central role in retrieving external knowledge necessary for the development of a first (educational and professional) concept of the new curriculum. The CURC (and especially the gatekeepers) play a central role in the gatekeeping and innovating process. In essence they play a central role as innovators (the main developers of the innovative concepts) in the process. The university board plays a central role in strategic terms, in providing the necessary means for the innovation and playing the role of a sponsor.

Characteristics of the crystallization phase:

- In this phase there is a central role for the strategic circle in the form of both decision makers in the faculty (dean and director of education) and opinion leaders from the dominant coalition (a number of professors with high standing). This last group has to act as boundary spanners, linking the ideas from gatekeepers to the majority in the faculty. This process fails the first time around as the group of opinion leaders is approached in a way that is already too much closed down in terms of underlying principles and contents. A second attempt to let major opinion leaders play the role of boundary spanners is successful. By doing this there is an integration between external knowledge, ideas from the CURC, and the field of professionals in the organization.

Characteristics of the evolution phase:

- The main role in this phase is played by the internal circle consisting of professionals at the operational level in the organization (members of BOTs and BUTs). Their role is to fill in the details, i.e. working out the core concept, actually developing and executing the new curriculum. There is a small role for dean and director and professors as the strategic groups that have to support and promote the innovation.

D. Core concept and learning model

In general the existence of a core concept and the learning model in this case can be summarized as follows:

Case	Reified core concept	Reflection and conceptualization	Experience	Learning style	Goal orientation
Case Pharmacy	Clear and agreed upon	Medium	Medium	Various learning styles	Personal knowledge building Problem solving

Display 10.5- Pharmacy V: Core concept and learning model

Phase	Reified core concept	Reflection and conceptualization	Experience	Learning style	Goal orientation
Idea generation <i>Description</i>	Ideas about the new curriculum could be expressed during study days. The CURC has done the preparation.	Start of the development and discussion about a concept for the renewal was initiated. Outside groups were consulted for ideas about the new curriculum.	By first giving shape to the new curriculum the professional field was consulted about the competencies starters need to perform their job well.	The professional field was used for information about the end terms for pharmacists. The IVLOS helped with information about new educational methods.	An important aspect was that the CURC gained knowledge about factors necessary for the development of the new curriculum.
<i>Result</i>	<i>Basic ideas</i> <i>Development of guidelines</i>	<i>High</i>	<i>Medium</i>	<i>Boundary spanning</i> <i>Competence acquisition</i> <i>Experimental learning</i>	<i>Personal knowledge building</i> <i>Problem solving</i>
Crystallization <i>Description</i>	As part of the process of initially going too far with the concept and then slightly back in the direction of the old situation, crystallisation of the core concept is achieved.	There were plenty of chances to express one's meaning, but you can doubt if people used these opportunities enough.	Teachers who had already developed one block talked with those with no experience with the process.	The concept was further developed on the basis of the input of professionals from within the faculty. BOT's were formed to bring the concept to a more detailed level.	Professionals within the faculty gained knowledge about the concept of the new curriculum and how to further develop this in more detail. Task had to be performed to take the concept to a more detailed level.
<i>Result</i>	<i>1. Existence of guidelines, not accepted</i> <i>2. Clear and agreed upon</i>	<i>Medium</i>	<i>Medium</i>	<i>Competence acquisition</i> <i>Continuous improvement</i>	<i>Personal knowledge building</i> <i>Task oriented</i>
Evolution <i>Description</i>	The core concept was used as a reference for working out the educational material.	The implementation was characterized by realising the concept, only small changes were made because of new insights.	There is much more integration, with people from different departments talking to each other exchanging experiences.	The concept was further improved. Continuously improving the education was possible, by sharing experiences and by trial and error.	The new curriculum had to be worked out in an educational program which could be offered to the students. Problems coming across during the implementation had to be solved.
<i>Result</i>	<i>Clear</i>	<i>Low to medium</i>	<i>Medium to high</i>	<i>Continuous improvement</i> <i>Experimental learning</i>	<i>Task oriented</i> <i>Problem solving</i>

Display 10.6- Pharmacy VI: Phases in relation to core concept and learning model

There are differences in the existence of a core concept and the used learning model according to the phase of the innovation and the role and position of the actor in the innovative process:

The idea generation phase is characterized by:

- *Basic ideas for a reified core concept:* in this phase the project team consults different external knowledge networks to form the first ideas for the innovation. These first ideas are described in the Blueprint. The ideas are used as guidelines for the following phases.
- *High levels of reflection and conceptualization:* the curriculum is designed from scratch and starts with the end terms. These end terms are created by reflection on information from actors in the professional field. These bring in knowledge about the content and competencies of a pharmacist. From educational experiences and theoretical insights on learning, basic ideas are developed on the educational principles. There is a dialogue within the CURC about several divergent ideas and alternatives, from this a basic idea (Blueprint) for the curriculum is developed.
- *Medium use of experience:* external networks, e.g. the professional field, are consulted about their experiences of the change in the profession of a pharmacist. The IVLOS uses implicitly their experience with other curriculum renewals as well. Experiences from within the faculty are not explicitly used in this stage.
- *Boundary spanning, competence acquisition and experimental learning style:* for the development of the new curriculum, external actors are consulted in order to provide input for the initial concept. The input consists of ideas about educational programs as well as the content that should be present in the curriculum. The CURC looks across the boundaries of the organization to acquire competencies not available within the organization and looks outside its own frame of reference.
- *Personal knowledge building and problem solving goal orientation:* In the development of the first basic ideas, new ideas and problems are generated. These are generated through the development of knowledge in the professional field and personal development of the people involved in the first phase, gaining knowledge to deal with big changes.

The crystallization phase is characterized by:

- *First guidelines and only secondly a clear and agreed upon reified core concept:* In the first instance the CURC provides guidelines for the development of the new curriculum to the chairmen of the BOTs. Only in the second instance does the core concept crystallise due to feedback from the group of professors on the non-acceptance of the guidelines. In cooperation between some prime members of the CURC (process manager, gatekeepers and other seniors), the director of education, and a selection of professors a core concept is built. Commitment and foundation for this concept is gained and the people in the organization, both within the internal and the strategic circle, agree to take this concept further.
- *Medium levels of reflection and conceptualization:* After the first big step is taken in the idea generation phase concerning reflections on the new curriculum, the next phase focuses more on the development of guidelines and even later on the core concept. There is some reflection and conceptualization needed for this, but the development of the core

concept is based on the first reflection on divergent ideas that takes place in the idea generation phase. Therefore these processes play a role to a lesser extent.

- *Medium use of experience:* small exchange of experiences is in place between the several block development teams. This improves and increases during the later stages of the innovation process.
- *Competence acquisition and continuous improvement learning style:* In order to develop the core concept, competences are needed, but not yet incorporated by most people in the organization. Further on, the development of the core concept into actual plans means an ongoing improvement of the first basic ideas, putting practical experiences and possibilities in practice.
- *Personal knowledge building and task oriented goal orientation:* the crystallisation phase is characterised by learning processes of the actors involved with the further development of the first concept. As a result they have an orientation towards their personal development. Besides this, there is an orientation towards completion of tasks for a successful implementation of the innovation.

The evolution phase is characterized by:

- *Guidelines and prescriptions and later on a clear reified core concept:* At first detailed guidelines are used, but later on this is replaced by an agreed upon and clear reified core concept that acts as the base for the new curriculum and is worked out in detail in the Faculty of Pharmacy.
- *Low to medium levels of reflection and conceptualization:* The whole framework and a lot of details are already in place, reflection and conceptualization are not used a lot. There is, however, some reflection on the results of the introduction of new educational forms and redesign in this aspect.
- *Medium to high use of experience:* People are getting more familiar with exchanging experiences within the new curriculum and increasingly regard it as value adding. The exchange of experiences is very practical now since the innovation is at a detailed level. A number of professionals start placing their earlier experiences in the new frame of reference, thereby developing new educational methods.
- *Continuous improvement learning style:* Executing the new curriculum is now a matter of filling in the last details and fine-tuning what already existed; next to that there is a continuous focus on further development of the curriculum.
- *Task oriented and problem solving goal orientation:* during the realisation of the curriculum renewal problems come forward, which have to be solved directly, and predetermined tasks have to be completed to implement the new curriculum in time.

E. Information processing

In general the progress of the information processing activities can be summarized as follows:

Case	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Case Pharmacy	Medium	Medium high	Medium high	Medium to high

Display 10.7- Pharmacy VII: Information processing

Phase	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Idea generation <i>Description</i>	Not really sufficient knowledge within the organisation; therefore the support from outside was important. Knowledge about the competencies of a pharmacist is imported from the professional field. For the educational methods IVLOS is consulted.	The imported knowledge had to be judged in the light of changes to the new curriculum.	The distribution of information occurred in the first phase, more or the less, only between members of the CURC.	The reactions from the professional field and the IVLOS are applied in coming up with the first basic ideas of a new curriculum.
<i>Result</i>	<i>High</i>	<i>High</i>	<i>Medium</i>	<i>Medium</i>
Crystallization <i>Description</i>	By translating the basic ideas into the concept new aspects are coming along. New ideas during the renewal are developed.	All the ideas about the new curriculum are integrated and interpreted in the light of a core concept.	During study days and symposia the rest of the organisation is getting much more involved, information needed to be distributed for these activities. Presence of knowledge was in place; in every BOT a person from the CURC and the IVLOS was present.	The opinions coming across during the study days and symposia are combined with the basic ideas and together are applied to a core concept.
<i>Result</i>	<i>Medium</i>	<i>Medium to high</i>	<i>High to medium</i>	<i>Medium to high</i>
Evolution <i>Description</i>	Only marginal new knowledge is imported by giving shape to the new educational program.	The core concept that remained gave small room for interpretation. The concept was already quite crystallised.	Obvious differences existed in knowledge of teachers relevant for the new educational methods and their way of working; therefore training was needed.	The core concept, changed into a detailed educational program, was now put in practice.
<i>Result</i>	<i>Medium to low</i>	<i>Medium</i>	<i>High</i>	<i>High</i>

Display 10.8- Pharmacy VIII: Phases in relation to information processing

Differences in the information processing activities vary according to the phase of the project and the role and position of the actors in these phases. The activities below are differentiated between the phases and the elements of the knowledge cycle.

Characteristics of the idea generation phase:

- *High knowledge acquisition*, since a lot of knowledge and information is acquired from the external network about the form and content of the new curriculum.
- *High knowledge interpretation* due to the interpretation of the acquired knowledge in the context of a thorough change in the old curriculum. Trends and emerging views about educational methods and changes in the profession of a pharmacist are interpreted.
- *Medium knowledge distribution* as the acquired and interpreted knowledge is used within a small group in the organization, and is only distributed on a small scale to the rest of the organization.
- *Medium knowledge application* in terms of using the knowledge for the development of the initial basic ideas and in applying external knowledge.

Characteristics of the crystallization phase:

- *Medium knowledge acquisition*, since most knowledge is acquired in the idea generation phase. The focus of this phase is on the further development of the concept, which means a small amount of new knowledge is required to work out the concept.
- *Medium to high knowledge interpretation* as the concept crystallises. To realize this, additional interpretations in relation to emergent ideas, practicability and fine-tuning are necessary.
- *High to medium knowledge distribution*, since, apart from the strategic circle, the rest of the organization is also involved, which requires the distribution of all kinds of information.
- *Medium to high knowledge application*, since the core concept is further developed into a more executable and detailed education programme.

Characteristics of the evolution phase:

- *Medium to low knowledge acquisition*, since not much new knowledge is obtained. There is an exchange of experiences, but for the organization itself this is not new knowledge as such.
- *Medium knowledge interpretation* as the focus is more on distributing and applying the present knowledge, than on interpreting it. However, due to the exchange of knowledge, all kinds of actors have to interpret this knowledge for their own situations.
- *High knowledge distribution* in the organization of informing everybody about the ongoing developments of the new curriculum.
- *High knowledge application* as details have to be made really clear now; the final product, the education programme, has to set ready for execution.

F. Political processes

In general the political processes during the innovative process can be summarized as follows:

Case	Between groups			Within groups		
	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Case Pharmacy	Medium-to-open	Medium	Medium-to-open	Open-to-medium	Open-to-medium	Medium-to-open

Display 10.9- Pharmacy IX: Socio-political processes

Phase	Between groups			Within groups		
	Information exchange	Foundations for relations	Character of communication	Relations	Goal orientation	Attitudes
Idea generation <i>Description</i>	Negative side effect of the configuration of the project team is that the professors were under-represented and limited the exchange of information in the first period of the curriculum renewal.	Depending on whether the persons involved are conservative or progressive, the first not really open for change.	People against the renewal had to be convinced in the first phase, to create foundation and commitment in the organisation.	The discussions within the CURC were very open. The configuration of the CURC was based on representatives of all departments, on innovative ideas and on willingness to change.	The ideas for the new curriculum are aimed towards a drastic change. Something had to happen to the old curriculum; therefore the new curriculum is designed from scratch.	Within the CURC the people involved were looking for a new form for the curriculum. The professional field and IVLOS were contacted about the requirements for a new curriculum.
<i>Result</i>	<i>Medium</i>	<i>Medium</i>	<i>Medium-to-closed</i>	<i>Open</i>	<i>Open</i>	<i>Open</i>
Crystallization <i>Description</i>	By involving more people in the renewal and by incorporating the BOTs the exchange of knowledge was improved.	People opposed to the change tried to slow down the process. More people now got involved in the change process.	The creation of the BOTs improves the communication between the professional in the organisation.	Due to an increase of people involved, conservative persons are joining as well.	The first ideas were discussed in the whole organisation, contributing to the development of the core concept.	The persons involved in the BOTs differed in their will to change. There were two types in the curriculum renewal, conservative and progressive people.
<i>Result</i>	<i>Medium closed → open</i>	<i>Medium closed</i>	<i>Open-to-medium closed</i>	<i>Open-to-medium</i>	<i>Open-to-medium</i>	<i>Medium closed-to-open</i>
Evolution <i>Description</i>	The whole organisation is involved and the exchange of experiences increases.	During the implementation a shift is taken place in how people are dealing with each other.	People are starting to communicate with people from other departments.	An exchange of experiences across all teams involved in the realisation of the educational program.	The realisation of the new curriculum is about putting the last details in place and an exchange of experiences about running the new education program.	The BUTs put the last detail in place for the new education program, hereby applying the core concept. There is a lot of communication between BUTs about the application of the core concept.
<i>Result</i>	<i>Medium-to-open</i>	<i>Medium closed-to-open</i>	<i>Open-to-medium</i>	<i>Open-to-medium</i>	<i>Open-to-medium</i>	<i>Medium-to-open</i>

Display 10.10- Pharmacy X: Phases in relation to socio-political processes

There are differences in the socio-political processes depending on the phase of the innovation process and the role and position of the different actors. The socio-political processes in the different phases can be described as follows:

Characteristics of the idea generation phase:

- A *mixture of a closed and open relationship among groups* where it concerns the development of the concept. Closed between groups within the organization. A limited exchange of information exists about the initial basic ideas with others than those on the project team. This is also due to the foundation for relations, which is influenced by existing coalitions. Communication is based on existing assumptions. However, between the CURC and the external network there is an open relationship. A frequent exchange of information with relevant outsiders occurs, whereby relations are influenced by the added value of the people involved. The communication is therefore based on dialogue.
- A *medium to closed relationship between groups* where it concerns the political discussion. The foundations for relations are influenced by the position of professionals in a specific department. Due to the shift in the curriculum from a product- to a patient-orientation, the influence of product-oriented departments decreases, and vice versa.
- An *open relationship within groups* in relation to the CURC in the development of the first basic ideas. Discussing openly different alternatives. The communication is based on dialogue and relations are influenced by the added value of other people.

Characteristics of the crystallization phase:

- A *medium-to-open relationship between groups* focusing on the discussion between the strategic and internal circle. The same holds for the relationship between the CURC and the block development teams and between the CURC and the strategic circle. At first the relationship between the CURC and others is rather closed since guidelines are imposed. After the revolt there appears to be a more open communication. Communication about the core concept and among groups in general improves quite well and the exchange of information increases significantly.
- An *open-to-medium relationship within groups* where it concerns the block development teams. A division among the several block development teams can be made, since some have open socio-political processes where others have more medium ones. The overall performance results in an open-to-medium relationship within groups. The relationships within the CURC remain open.

Characteristics of the evolution phase:

- A *medium-to-open relationship between groups* concerning all the teams involved in the innovation process. The exchange of experiences slowly increases and the existing power coalitions are already a bit reshuffled, due to the shift in the curriculum. As a result of the configuration of the new curriculum, which is much more integrated, the horizontal communication between departments improves.
- An *open-to-medium relationship within groups* concerning the execution of the new curriculum. Due to the newness of the new education programme, people have to build up a routine. The relationships within groups therefore improves along the way.

G. Organizational conditions

The results of the organizational conditions in the curriculum renewal are given only in overview, thus not in relation to the several phases. This is because this aspect does not form a main element of the process design model. An overview of the elements in terms of organizational conditions is presented below.

Case	Room for reflection and meta-cognition	Stimulation of participation in external knowledge networks
Case Pharmacy	<i>Medium</i>	<i>Medium</i>

Display 10.11- Pharmacy XI: Organizational conditions

- *Medium room for reflection and metacognitive activity:* the space for proposing ideas was present, but had to fit in the framework already put forward by the CURC. The concept set by the project team is consequently quite rigid, but new insights and ideas within this framework are considered. This room for reflection and metacognitive activity was high in the first phase and decreased in importance during the process to a medium level.
- *Medium stimulation of participation in external knowledge networks:* the CURC gained knowledge and experience from outsiders of the organization in order to put forward an initial concept. They are allowed abundant space by management to do this. Later on, during the development of this concept by other teams, they are stimulated to share experiences and knowledge with the other teams working on the development of the concept. However, the level of stimulation remained around medium during the curriculum renewal.

11. CONCLUSIONS CASE STUDY PHARMACY

The major research questions for the second part of this case study are:

1. What are the processes that lead to the creation of radical innovations in KISFs?
2. What are the characteristics of different phases in the creation of these innovations?
3. What are the organizational conditions that facilitate the creation of radical innovations?
4. Can the process of creating radical innovations be influenced by adequate application of the process design model for radical innovations?

In order to deal with this question we shall relate in this chapter the findings from the case study Pharmacy and other case studies to the variables for this study (11.1). In order to compare the effects of the application of the process design model to the other cases, we shall also incorporate the results from the other case studies in this paragraph. Then we discuss the proposition related to the application of the process design model and its constituting practical design components (11.2), we present some methodological considerations (11.3) and finally we present the answers to the research questions (11.4).

Part two of this study was performed by a researcher, who undertook this research as a masters project in Economic Sciences. This project was aimed not only at performing the second part of this study but also at incorporating a critical review of the developed process design model, based on both an additional literature study and additional research questions and propositions. The findings from this critical review are, where relevant, incorporated in the conclusions and discussion.

11.1 CONCLUSIONS

The main variables that are examined are: Radical innovation: success and function of the innovation, adequate application of the process design model and phases of innovations, learning model, information processing activities, socio-political processes, room for reflection and meta-cognitive activities and stimulation of participation in knowledge networks. On the basis of the case study some conclusions about different actors in the different phases are included as well.

11.1.1 Radical innovations: success and function of the innovation

The case Pharmacy is considered as a highly successful innovation according to our criteria, there was a positive score on all 5 criteria for success.

There is a less clear picture on the degree in which the innovation is radical: 2 scores out of 4 are positive (basis for developments and new insights in the professional community). The generalization to the professional community is scored as medium (although a number of the innovations are now used as standards for 'good practice' within the University Utrecht). The score on status in the professional community is scored as medium to negative as the name of the faculty is not (yet) linked to this new concept (at least outside the university). In general there has not yet been a lot of PR about the curriculum Pharmacy. As the innovation was only introduced in the autumn of 2001 (first year out of six), there has not been a lot of time for the innovation to become

known. However, the other pharmacy and pharmacy-related faculties in the country see the developments in Utrecht as a threat to their market share. In answer to this they started their own renewals. They are, however, choosing to adopt different models, in order to have their own clear identity.

In general the innovation is considered as radical by the respondents in the case study. They state that a paradigm shift has taken place.

In general we tend to label this innovation as radical, but a solid proof still needs to be given over the coming years.

11.1.2 Adequate application of the process design model

Phase	Idea generation	Result	Crystallization	Result I → II ¹	Evolution	Result I → II
Learning processes	Reflection and conceptualization	+/0	Boundary spanning/ Experimental style geared towards concept creation	- → +	Processing of experiences	0 → +
	Boundary spanning	+	Personal knowledge building and problem solving aimed towards concept creation	- → +	Boundary spanning and continuous improvement	0 → +
	Experimental learning style	+/0	Knowledge interpretation		Problem solving and task oriented learning style	+ → +
	Personal knowledge building in the context of the issue	+	Creation of a core concept			
Information processes	Acquisition of knowledge from external networks	+	Identification of boundary spanners	-- → +	Distribution of the core concept	-- → +
	Interpretation of external knowledge in the context of the innovative issue	+	Stimulation of boundary spanners to import knowledge and interpret knowledge in order to create a core concept (enhancing absorptive capacity)	-- → +	Knowledge application: placing experiences and insights in the new frame of reference and developing innovations	0 → +
Political processes	Identification of gate keepers	+	Creation of alignment on the core concept and creation of a new frame of reference	0 → +		
	Room and time for knowledge acquisition and interpretation (open connections)	+			Interactive processes within the frame of reference	0/+ → +
	Facilitation of primary absorptive capacity	+				
Output	Basic ideas Development of guidelines		I: Guidelines that are not agreed II: Clear and agreed upon concept Enhancement of absorptive capacity		I: guidelines worked out in plans II: innovative artefacts in context of concept Incremental innovative capacity	

Display 11.1: Adequate application of the process design standards

¹ The results in both the first and second attempt towards crystallization and realization

From the findings it appears that the practical design components are applied adequately in the *idea generation* phase. This leads to the development of basic ideas (also rooted in a setting where room for adequate autonomous strategic capacity is created) and subsequently to guidelines for the next stages of the innovative process.

In the *crystallization phase* the practical design components are, in the first instance (phase I in display 11.1) not adequately applied. There is no identification of boundary spanners from the dominant coalition. As such, they can play no role in the importation of knowledge and the creation of a core concept. Because guidelines are formulated by the CURC, there is no collective processing of the basic ideas geared towards concept creation. In essence there are two major pitfalls in the application of the process design components in this phase:

- Too little attention for the socio-political processes; no identification of boundary spanners; no open relations between gatekeepers and boundary spanners; and therefore no collective interpretation and experimentation within the combination of gatekeepers and boundary spanners.
- There is an emphasis on the development of guidelines that prescribe the innovations to be realized rather than an emphasis on a more abstract concept that leaves room for information processing and learning processes by professionals.

As a consequence there is no reified core concept created and absorptive capacity is not enhanced. This all leads to a revolt against the innovations.

A second attempt (phase II in display 11.1) is undertaken to go through the crystallization phase again. This time the practical design components are adequately applied. This leads to the creation of a reified core concept and the enlargement of absorptive capacity. The starting point for a period of incremental innovation is created.

Because the *evolution phases* starts without proper accomplishment of the crystallization phase, it is not possible to rightly apply the practical design components in the evolution phase. As there is no core concept and thus no distribution of the core concept to the rest of the organization, processing and reframing of experiences and knowledge application in the context of the core concept is not possible. This leads to innovative plans that are only partly successful and lead to dissatisfaction within the community of the faculty. After the crystallization phase is revisited and practical design components are rightly applied, it is possible to re-enter the evolution phase for a second time. This time the practical design components can be applied properly. This leads to the creation of a number of innovative artefacts and to the creation of a period of incremental innovation within the new frame of reference.

In general it can be concluded that the process design model was adequately applied in the end, but this was only accomplished after shortcomings in the original application of the process design model during the crystallization and evolution phase.

The shortcomings in the application of the process design model led to unsuccessful products of the crystallization and evolution phase: no creation of absorptive capacity, no reified core concept, and a realization of innovations but no incremental innovative capacity.

After adequate application of the process design model, the output confirms the predictions of the model:

- Idea generation phase: preliminary ideas for radical innovation and open connections between the relevant external networks and the organization.
- Crystallization phase: a reified core concept, alignment on this core concept and enhanced absorptive capacity.
- Evolution phase: implemented innovative activities, a continuous incremental improvement.

In general it can be concluded that there is a need to accomplish each phase in a satisfactory way in order to enter the next stage. It should be determined whether or not the output has been realized before the next phase can be properly started.

11.1.3 Actors

At the outset of our research study we identified three circles of actors in the innovation process. In the process design model we elaborated on this by naming different actors in the process, but we did not give them an explicit role. On the basis of the findings in our last case we feel there may be an added value in defining different actors and their roles during the different phases of innovation. A secondary analysis of the data on the case study Pharmacy shows that the following actors have a role:

Phase	Circle	Actor	Role
Idea generation	External circle → strategic circle	Gate keeper Innovator Promotor/sponsor	Nod between the organisation and external knowledge network Creating ideas out of external knowledge Providing strategic back up/ providing necessary means
Crystallization	External circle → Strategic circle	Gatekeeper Boundary spanners Promotor/sponsor	Coupling external knowledge to basic ideas Linking gate keepers/innovators and their ideas to the rest of the organization Participate in creating core concept Providing commitment/ foundation
Evolution	Strategic circle → internal circle	Boundary spanners Promotor Supporters	Take responsibility for the core concept Providing means and support Realizing actual innovations and taking care of continuous improvement

Display 11.2: Circles, actors and roles in the different phases in the case Pharmacy

In the *idea generation phase* there are a number of gatekeepers and innovators combined in the CURC. They take care of importation of new knowledge without the existing frame of reference

(esp. new educational insights and a move away from a product-oriented pharmacist towards a more patient-oriented pharmacist). There is also a role for top management in creating a backup for the changes and providing means (time and money) for participation in knowledge networks, importation of knowledge, and room for the creation of basic ideas.

In the *crystallization phase* there is originally only a role for gatekeepers and innovators (providing guidelines and prescriptions), supporters (working out of plans conform guidelines and prescriptions) and a promoter/sponsor (top management approving of the guidelines and providing means for further realization of plans). Later on there is a clear group of boundary spanners (professors responsible for educational lines in the program) who have a role in creation of core concepts and headlines for the innovation.

In the *evolution phase* there is originally a strong role for the gatekeepers/ innovators and for supporters. The gatekeepers/innovators steer the creation of actual innovation. Chairmen of the BOTs have a rather marginal role. In the second instance, there is a stronger role for boundary spanners, both in steering the innovations within the terms of the core concept and educational lines (as chairmen of BOTs and as members of an advisory committee on the changes) as well as in playing a role in continuous innovations. Top management plays a role in providing means and continuous support for the contents of the changes.

It can be concluded that the process design model will have to be elaborated to cater to the incorporation of different actors and their roles.

11.1.4 Core concept

Phase	Idea Generation	Crystallization I	Evolution I	Crystallization II	Evolution II
Successful cases	Orientation Development of basic ideas	Creation of a core concept agreement	Reified core concept serves as a basis for incremental innovation	--	--
Unsuccessful Cases	Development of rudimentary ideas	Compromised concepts Diffusion and differentiated application	Application of changing concepts No reified core concept	--	--
Result Pharmacy	Orientation Basic ideas Guidelines	Guidelines Not accepted	Guidelines and prescription	Clear and agreed upon core concept	Clear and agreed upon core concept

Display 11.3: Creation of a core concept

In general it can be concluded that an adequate application of the process design model leads to creation of a reified core concept that forms the basis for the creation of radical innovations. From our findings it can also be concluded that the creation of a core concept is essential for the creation of radical innovations.

Core concepts that are the basis for the creation of radical innovations need to have the following characteristics:

- They should be agreed on by opinion leaders from the dominant coalition of knowledge-intensive service workers (and have to be accepted eventually by this dominant coalition).
- They have to be unambiguous (no pseudo crystallizations with moving frames and meanings).
- They have to be stated at a level that is sufficiently abstract and leaves room for knowledge-intensive service workers for interpretation of their own experiences and for creation of continuous improvements in the new frame of reference (no guidelines or prescriptions).

11.1.5 Learning model

Reflection and conceptualization

Phase	Idea Generation	Crystallization	Evolution
Successful cases	High	High/Medium	Low/medium
Unsuccessful cases	Medium	Medium	Low/medium
Result Pharmacy	High	Medium	Low/medium

Display 11.4: Reflection and conceptualization

In general it can be concluded that application of the process design model leads to the creation of high levels of reflection and conceptualization in the idea generation phase, medium levels in the crystallization phase and low to medium levels in the evolution phase. This is in line with the results from the successful cases and the positive effects of the stated levels in the different phases on the creation of radical innovations.

Experiences

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Medium	Medium	High
Unsuccessful cases	Medium	Medium	Medium/high
Result Pharmacy	Medium	Medium	Medium/high

Display 11.5: Experiences

It can be concluded that application of the process design model leads to a medium use of experiences during the idea generation and crystallization phase and to medium-to-high levels of experience use in the evolution phase. This is in line with the results from the successful cases and the positive effects of the stated use of experience in the different phases on the creation of radical innovations.

Learning style

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Experimental Boundary spanning	Experimental Boundary spanning	Boundary spanning Continuous improvement
Unsuccessful cases	Experimental Acquisition Boundary spanning	Diverse	Continuous improvement Boundary spanning
Result Pharmacy	Boundary spanning Competence acquisition Experimental learning	Competence acquisition Continuous improvement	Continuous improvement Experimental learning

Display 11.6: Learning style

The application of the process design model does not lead to the same learning styles as in the successful cases. For the idea generation phase and the evolution phase there is some overlap (resp. boundary spanning/experimental learning and continuous improvement). There is a major difference in the crystallization phase. The conclusion can be drawn that there is no significant role for learning styles in this phase.

Goal orientation

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Personal knowledge building Problem solving	Personal knowledge building Problem solving	Problem solving Task oriented
Unsuccessful cases	Personal knowledge building Problem solving	Problem solving Task oriented	Problem solving
Result Pharmacy	Personal knowledge building Problem solving	Personal knowledge building Task oriented	Problem solving Task oriented

Display 11.7: Goal orientation

The application of the process design model leads in general to the creation of nearly the same goal orientations in learning as in the successful cases. It can also be concluded that a personal knowledge building style (in combination with problem solving that keeps in the area of the innovative issue) in the idea generation and crystallization phase, and a problem solving goal orientation in the evolution phase are essential for the creation of radical innovations.

11.1.6 Information processing*Knowledge acquisition*

Phase	Idea Generation	Crystallization	Evolution
Successful cases	High	High/Medium	Medium
Unsuccessful cases	Low/medium	Medium	Low
Result Pharmacy	High	Medium	Medium/low

Display 11.8: knowledge acquisition

The application of the process design model leads to nearly the same processes of knowledge acquisition as in the successful cases. It can be concluded that application of the model leads to high knowledge acquisition in the idea generation phase, medium in the crystallization phase and low levels in the evolution phase. These patterns lead to successful radical innovation.

Knowledge interpretation

Phase	Idea Generation	Crystallization	Evolution
Successful cases	High	High	Low/medium
Unsuccessful cases	Medium/low	Medium/low	Medium/low
Result Pharmacy	High	Medium/high	Medium

Display 11.9: Knowledge interpretation

The application of the process design model leads to the same processes of knowledge interpretation in the case Pharmacy as in the successful cases. It can be concluded that application of the model leads to high knowledge interpretation in the idea generation phase, high to medium in the crystallization phase and medium levels in the evolution phase. These patterns lead to successful radical innovation.

Knowledge distribution

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Low	Medium	High
Unsuccessful cases	Low	Medium	Medium
Result Pharmacy	Medium	High/medium	High

Display 11.10: Knowledge distribution

The application of the process design model leads to nearly the same processes of knowledge distribution as in the successful cases. The difference between the successful cases and the case pharmacy can be declared by the fact that there is emphasis on the distribution of guidelines in the crystallization phase. It can be concluded that application of the model leads to medium knowledge distribution in the idea generation phase, high medium levels in the crystallization phase and high levels in the evolution phase. These patterns lead to successful radical innovation.

Knowledge application

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Low	High	High
Unsuccessful cases	Low	Medium	Medium
Result Pharmacy	Medium	High/medium	High

Display 11.11: Knowledge application

The application of the process design model leads to nearly the same processes of knowledge application as in the successful cases. It can be concluded that application of the model leads to

low-to-medium knowledge application in the idea generation phase, high levels in the crystallization phase and high levels in the evolution phase. These patterns lead to successful radical innovation.

11.1.7 Socio-political processes

Between groups

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Open	Medium	Closed
Unsuccessful cases	Closed/medium	Closed	Closed
Result Pharmacy	Medium	Medium closed	Medium

Display 11.12: Political processes between groups

There is no proper application of the process design model regarding the political processes between groups the first time round. This is especially clear in the crystallization phase since there is in the successful cases a move from open to closed, while there is a move from closed to open in the case pharmacy. This may well have to do with setting prescriptive guidelines in the first instance (closed processes) and involving boundary spanners in a more open information exchange in the second instance (open processes). There is, however, also a difference in the idea generation phase, although it was stated earlier that in this phase the process design model was applied in the proper way. This can be shown by the fact that relations between two different groups are measured in the first part (cases Medical Education, Social Sciences, Pig City and Lite City) and in the second part of the study (case Pharmacy). In the first part of the study, the relations between the external knowledge network and gatekeepers and innovators are measured in the idea generation phase. In the second part of the study, the focus is on both relations with the external network and on relations within the organization (between gatekeepers and boundary spanners). The relations between the external network and gatekeepers and innovators are reported to be open. The relations between groups within the organization are reported to be closed. When we account for these differences in measurement, there is no difference between the case pharmacy and the successful cases. We can conclude then that the process design model is applied properly for the idea generation phase, but not for the crystallization (and therefore evolution) phase, the first time round. In a second attempt application is corrected and performed adequately. In general it can be concluded that proper application of the process design model leads to political processes between groups that are beneficial for the creation of radical innovations. But from the experiences in the case pharmacy it can also be concluded that inadequate application of the process design model regarding political processes among groups in the crystallization phase can frustrate the creation of radical innovations.

Within groups

Phase	Idea Generation	Crystallization	Evolution
Successful cases	Open	Open → closed	Medium
Unsuccessful cases	Medium/open	Medium/closed	Closed → open
Result Pharmacy	Open	Open to medium	Open to medium

Display 11.13: Political processes within groups

In general it can be concluded that the process design model related to political processes within groups is adequately applied in the case Pharmacy. It can further be concluded that adequate application regarding the relations within groups leads to the creation of radical innovations.

11.1.8 Organizational conditions

Phase	Room for reflection and meta-cognition	Stimulation of participation in external knowledge networks
Successful cases	Medium-low	Low-high
Unsuccessful cases	High-medium-low	Low-high
Result Pharmacy	Medium	Medium

Display 11.14: Organizational conditions

On the basis of part one of this study, no explicit practical design components on organizational conditions are incorporated in the process design model. The model is not relevant as such to this item. Still, it appears from the cases that there are conditions that are beneficial to innovation, and there is a role for management in this process. The blurred picture on this item may be due to the fact that this subject was not explicitly researched. We will elaborate on this in the next paragraph.

11.2 FINDINGS RELATED TO THE PROCESS DESIGN MODEL AND PROPOSITIONS

In this section we relate the findings from the case Pharmacy and the other four cases to the process design model and the accompanying practical design components.

Adequate application of the process design model will generate better results in radical innovation than the results from the unsuccessful cases

This proposition holds. The process design model is, with some obstructions, applied in an adequate way. This has finally led to the creation of a successful innovation that is considered radical. Some proof of the degree of radicality of the innovation still needs to be given, but the tendency is towards a judgement of the innovation as radical.

11.2.1 General practical design components

1. *For the creation of radical innovations in KISFs it is necessary to design a process that is based on the proceedings of design activities through three phases:*
 - a. *An idea generation phase .*
 - b. *A crystallization phase.*
 - c. *An evolution phase.*

These phases have to be designed in such a way that they are in general successive, but essentially conditional in sequence. The progression through a phase is hampered if the former phase has not been successfully completed. There is some amount of overlap and interaction between the phases (leading to completion at higher and more appropriate levels).

This practical design component is confirmed, since there are clearly three phases that can be distinguished. From the problems in the initial crystallization and evolution phase, it can be deduced, that the output of each phase needs to be properly accomplished before the next phase can start. Improper accomplishment leads to problems in the innovative process later on and impedes the creation of innovations. In this sense, it seems justified to use the term 'phases' rather than 'episodes', since the latter relate to iterative and sometimes discontinuous processes. The term 'episode' seems to describe the proceedings of innovative activities during the incremental innovation rather than the first stages of radical innovation.

2. *The process of radical innovation has to be designed in such a way that it results from the outcomes of three underlying processes that constitute the innovative process:*
 - d. *Learning processes.*
 - e. *Information processing.*
 - f. *Socio-political processes.**These processes are interrelated and have to be designed and managed in an interdependent mode.*

This practical design component is confirmed. In all three phases the three processes occur and are strongly interrelated (for example, the combination of knowledge acquisition and reflection and conceptualization in combination with experimental styles and personal knowledge building leads to the creation of basic ideas for innovation). However, on the basis of the five cases studies and especially the obstructions in the case study Pharmacy we want to conclude that not all processes are equally important during the different phases. There seems to be an emphasis on:

- *The idea generation phase:* information processing (knowledge acquisition) and learning model (reflection and conceptualization, experimental learning style and personal knowledge building).
 - *The crystallization phase:* socio-political processes (with open processes leading to the exchange of knowledge and idea formation between gatekeepers and boundary spanners, which later closes down once the core concept has been created).
 - *The evolution phase:* information processing (knowledge distribution and knowledge application) and learning model (reframing and remodelling of experiences, a continuous improvement learning style and a problem solving and task oriented goal orientation).
3. *Successful innovative processes have to be steered in terms of not only content output but also of socio-political output.*

In relation to our statements on the preceding practical design components, this design component is confirmed particularly in the crystallization phase. In the other phases the output of socio-political processes seems to be less critical for the proceedings of the innovative process.

11.2.2 Practical design components for the idea generation phase

4. *The focus of the idea generation phase should lie in information processing activities. These information processing activities have to be aimed at the acquisition of new knowledge from external networks, the importation of this new knowledge into the organization, and the (preliminary) interpretation of this knowledge in the context of the innovative issue (the issue demanding for innovation). These information processing activities are in general performed by single persons, who can be defined as gate keepers.*

This practical design component is confirmed, since the importation and preliminary interpretation of knowledge during the idea generation phase, is essential for the creation of basic ideas underlying innovation. The gatekeeper has a central role in this process. It seems, however, that multiple gatekeepers can perform this task. These have to be coordinated. In general, in this phase the role both of gatekeeper and innovator can be discerned; it is not clear yet whether these two roles are united in one person or can be enacted by different actors.

5. *In the idea generation phase, learning style that are supportive of the information processing activities have to be applied:*
 - a. *Boundary spanning learning styles supportive of knowledge acquisition and importation.*
 - b. *Experimental learning styles supportive of knowledge interpretation*
 - c. *A dominant goal orientation aimed towards personal knowledge building in order to stimulate knowledge acquisition and interpretation.*
 - d. *A secondary goal orientation aimed towards problem solving in order to keep the acquisition and interpretation of knowledge within the boundaries of the innovative issue.*

The practical design component is confirmed; it is crucial for the development of basic ideas during the idea generation phase when learning processes take place. An aspect that is not mentioned but is important in the idea generation phase is the process of reflection and conceptualization on the basis of imported knowledge. It is this process in combination with experimentation and personal knowledge building that seems to form the core for the creation of basic ideas. The question that can be asked is whether reflection and conceptualization are the same as knowledge interpretation. In general, knowledge interpretation can be seen as a general activity, while reflection and conceptualization are a way in which knowledge is interpreted.

For goal orientation the emphasis is on personal knowledge building. Problem solving seems to be a secondary orientation that prevents lingering from the innovative issue at hand.

6. *Both top management and senior professionals have to use their central role in the management of socio-political processes. These socio-political processes have to be geared towards:*
 - a. *Use of strategic recognition capacity for the selection of valuable information processing activities and the identification of prime gate keepers.*
 - b. *Creation of room and time for knowledge acquisition and interpretation activities by gate-keeper(s) without demands for immediate returns.*

- c. *Support of the importation of acquired (and interpreted) knowledge into the organization (facilitation of primary absorptive capacity by other decision makers and opinion leaders).*

This practical design component has not been addressed directly. From our analysis of the roles in the innovative process and of the critical assessment of the process design model by the independent researcher, it becomes clear that during the idea generation phase there is a role for top management in creating strategic recognition capacity, as top management has to select and support basic ideas underlying the innovative process. Top management has to recognise prime gate keepers and has to provide them with room for knowledge acquisition (participation in external knowledge networks) and learning activities that are geared towards knowledge and idea building rather than towards direct problem solution (room for reflection and conceptualization and room for personal knowledge building). The linking of gatekeepers to boundary spanners (point c) is relevant in the crystallization phase rather than in the idea generation phase.

- 7. *The output of a successful idea generation phase can be defined as:*
 - a. *Contents: basic ideas for radical innovation (outlines for new frames of reference).*
 - b. *Process: open connections between relevant external networks and the organization and acceptance of gatekeepers functioning as nodes.*

This output is found in the successful cases (including the case Pharmacy). Consequently the stated output seems to give a proper description of the output that needs to be generated in the idea generation phase and that has to be accomplished before entering the crystallization phase.

11.2.3 Practical design component for the crystallization phase

- 8. *The focus of the crystallization phase should be aimed at information processing activities and socio-political processes. The information processing activities have to be aimed mainly towards knowledge interpretation in the light of the creation of a core concept for the innovation. The socio-political processes have to be aimed towards the acceptance of the core concept within the organization and the start of reframing experiences in the organization within the new frame of reference.*

This practical design component is confirmed. In application it appears, however, that there is a need for especially open socio-political processes between boundary spanners and gatekeepers within this phase. Open socio-political processes are conditional for mutual information processing activities.

- 9. *In the crystallization phase applied learning styles in the organization should support information processing activities related to importation and interpretation:*
 - a. *Boundary spanning learning styles supportive of importation of acquired knowledge.*
 - b. *Experimental learning styles supportive of knowledge interpretation in the light of concept creation.*
 - c. *A goal orientation aimed at personal knowledge building in order to stimulate knowledge interpretation and concept creation.*

- d. *A goal orientation aimed towards problem solving in order to interpret knowledge in the context of the innovative issue and to create a core concept for the issue at hand.*

This practical design component is neither confirmed nor rejected. It appears that the specific character of applied learning styles during the crystallization phase is of no great importance for the creation of a reified cored concept. There is room both for reflection and conceptualization and use of experiences, for different learning styles and for different goal orientations.

10. *Create socio-political processes that are characterized by:*

- a. *A significant role for both gatekeeper and boundary spanners, the latter consisting of a group of decision makers and opinion leaders with core position in the organization (or the relevant network of decision makers). The selection of the group of boundary spanners is a crucial aspect in the proceedings for the crystallization phase. Boundary spanners have to provide both for a core position in the organization and an open attitude towards innovation. Collective brokering might help in this process, since multiple links between the gatekeeper and the organization are created, but it may be detrimental where there are strong conflicts of interests between the various boundary spanners.*
- b. *Open relations between the gatekeeper and the boundary spanners, with a role for the gatekeeper in bringing the information to the organization and a role for the boundary spanners in the actual importation of knowledge into the organization and in the interpretation of the organization in the light of an approach towards the innovative issue (enhancing absorptive capacity and creation of the core concept).*
- c. *Closing down the social process after the core concept is created in order to enhance alignment in the organization on the reified core concept and chosen frame of reference.*

This practical design component is essential for the creation of radical innovations. The creation of proper socio-political processes appears to make the difference between uncommitted idea building and the actual creation of innovations. The creation of open political processes is an essential condition for the occurrence of information processing activities aimed towards the creation of a core concept. Therefore we want to state that the creation of open socio-political processes in this phase are an essential condition for integrated information processing and thus for the creation and acceptance of a reified core concept. The reified core concept and the agreement reached on it create mutual commitment between gatekeepers and boundary spanners (alignment and engagement). In order to create a core concept and agreement, open political processes have to be created between gatekeepers (who are already identified in the idea generation phase) and boundary spanners (who have to be identified at the onset of the crystallization phase). From the case Pharmacy it appeared that boundary spanners play an important role in importing new and deviant knowledge into the organization and in accepting the core concept by the majority of professionals. It did not become clear whether closed socio-political processes are necessary for this last step.

11. *The output of a successful crystallization phase can be defined as:*

- a. *Contents: a reified core concept as the basis for the actual innovation.*

- b. *Process: stage one: enhancement of absorptive capacity, stage two: alignment on the chosen frame of reference.*
- c. *The reified core concept has to form a clear and illustrative frame of reference but also has to be stated at a level of abstraction that leaves room for the interpretation and realization of the innovation by the professional in the process of service provision.*

This practical design component on the output of the crystallization phase is partly confirmed. Successful application of the process design model leads to the creation of a reified core concept that forms the basis for successful radical innovation. From the failure of the case Pharmacy in the evolution phase, in the first instance, it can also be deduced that guidelines and prescriptions rather than an abstract core concept leads to resistance of the radical innovation and to an impediment on the following incremental innovative process.

It was not analysed whether an enhancement of absorptive capacity was really created in the successful cases. As such, this part of the practical design component cannot be confirmed. It becomes, however, clear that alignment on the chosen frame of reference is essential for success in the next phase (the evolution phase).

11.2.4 Practical design components for the evolution phase

- 12. *In the evolution phase the emphasis has to be on learning activities and information processing activities. There is no strong role for socio-political processes.*

This practical design component can be confirmed, since there is a difference in the character of the socio-political processes among and within groups, while there is a largely coherent picture for learning and information processing activities in the idea generation phase in the successful cases (except for learning style).

- 13. *Interactive processes have to occur mainly within groups, and have to be aimed towards knowledge exchange within the chosen frame of reference thereby stimulating continuous incremental innovation.*

This practical design component can be rejected, as there are also medium open relations between groups in this phase in the case Pharmacy. It is clear that knowledge exchange takes place within the chosen frame of reference and that this coincides with continuous incremental innovation. It was not researched whether knowledge exchange within the chosen frame of reference is conditional for the creation of continuous incremental innovation.

- 14. *Information processing activities have to be geared towards:*
 - a. *Knowledge distribution of the reified core concept as a new frame of reference for activities in the organization and for plans that are derived from this core concept.*
 - b. *Knowledge application as experiences and insights are placed in the new frame of reference and translated into innovative activities.*

This practical design component can be confirmed, since there was an emphasis on knowledge distribution and application in the context of the new frame of reference (the reified core concept was clearly communicated in second attempt towards crystallization and evolution and was subsequently used as a touchstone for all developments and innovations).

15. *Applied learning styles have to be created that focus on:*
- a. *Processing of experiences, whereby these experiences (both in the pre-innovation and post-innovation situation) are placed in the new frame of reference and translated into innovative activities (both initial innovation and continuous innovation).*
 - b. *A combination of boundary spanning and continuous innovation, whereby experiences from others are used to shape the innovative process in terms of further improvement and re-invention.*
 - c. *A problem solving and task oriented goal orientation that is aimed towards the solution of practical problems arising in the process of the implementation and application of innovative activities.*

Part a of this practical design components is confirmed. In the case Pharmacy (in the second instance) learning models are created based on the processing of experiences within the new frame of reference. This leads both to initial innovations and to continuous innovative activities. The learning style is, however, a combination of continuous improvement and experimental learning; this does lead to further improvements and re-inventions. Boundary spanning in the evolution phase consequently plays no essential role in the creation of improvements and re-inventions. The creation of a goal orientation towards problem solving and task orientation is beneficial for continuous innovation. It is not clear whether this orientation is essential for the solution of practical problems in the process of the implementation and application of the innovative activities.

16. *The output of a successful evolution phase can be defined as:*
- a. *Contents: implemented innovative activities.*
 - b. *Process: processes of continuous incremental improvement.*

This practical design component on the output of the evolution phase is confirmed. Successful application of the process design model leads to the creation of both implemented innovative activities and a process of continuous incremental improvement. From the failure of the case Pharmacy in the evolution phase in the first instance, it can also be deduced that guidelines and prescriptions rather than the abstract core concept lead to literal obedience towards these prescriptions. This is detrimental to the creation of a process of continuous incremental improvement. From the critical review of the process design model (Muller, 2004) it appears, however, that there is also a strong need for both a structure and a culture that facilitates and enhances the creation of a continuous innovative process. In this sense it can be stated that the isolated application of the process design model in the evolution phase is in itself a necessary but not sufficient condition for the creation of a process of continuous incremental improvement.

METHODOLOGICAL CONSIDERATIONS AND LIMITATIONS TO THIS STUDY

Construct validity

Some critical remarks can be made about the construct validity of this study:

- *Construct validity of the variables:* Most variables are defined at the onset of this study or during the study. All 5 cases are analysed on the basis of the same definitions of the variables (case 1 and 2 are analysed retrospectively on some variables, but definition and use of the variables is used in an equal way for the data from all 5 cases). The variable application of the process design model was developed for the second part of this study. Formulation of this variable was based on the outcomes of the first part of our study. The construct was thoroughly researched and tested. The variable actors, however, was only constructed on the basis of the findings of the last study. This variable was not included explicitly in the data collection protocol for the cases. The variable is only used to describe the data in the last case. This means that the internal validity for this item is still limited. Due to restricted data collection on this item, there is still no analytical generalization possible, since there is no literal or theoretical explanation for the findings. Further testing of this variable will be necessary for future research.
- *Procedure for data collection:* there is a major difference in the procedure for data collection between the first four case studies and the last case study (testing of the application of the model) for the data on the last case was collected and interpreted by a different researcher. This researcher, however, followed the same data collection and analysis protocol developed for the first four cases: sampling of data from different sources, coding the data according to a coding scheme, data reduction in conceptually ordered displays that are ordered in the same way for the rest of the case studies. We feel that this similarity in data collection and protocol allows for a comparison between the cases in the first part and the case in the second part of this study.

External validity

One of the critical remarks regarding this study that can be made concerns the external validity. Our 5 case studies were conducted in 2 organizations, an architectural firm and a university. In the university 3 different faculties were researched. The question can be asked how valid our research, in 2 organization with an N =5 sample, is for the whole group of KISFs. This can be related to a number of aspects.

- *Generalization:* As stated, our research project contains 5 cases; this may allow for generalizing the findings to a larger universe than a single case study research or an N=1 experiment might allow. However, a research study on such a small number of cases may not allow for powerful statistical significance. To compensate for this we provide an analytic rather than a statistical generalization. This is done by creating a literal and theoretical explanation of our research findings, excluding rival explanations and pattern finding. De Leeuw (1996) mentions in this context the soundness of the research project as relevant to the validity. By providing for analytical generalization, the soundness of this study is ensured.
- *Validity for radical innovation processes:* As our study in all cases concerns innovative processes that are related to a fundamental change in the primary process of service provision, we feel that there is a high degree of external validity for the subject we chose: radical innovations in KISFs.

- *Validity for the type of organizations:* In our case studies both private and public KISFs were represented, providing a certain degree of external validity in a wide range of both private and public KISFs. Due to the opportunity to apply the process design model in a university, our choice of public KISFs is somewhat restricted, possibly diminishing the external validity of this study.
- *Heuristic value:* Our process design model and its practical design components can be considered as heuristic rather than as algorithmic types: there is a larger degree of external validity with an increase in similarity between the field situation and the characteristics of the case studies in this research project (van Aken, 1994). It will be up to the user of our model in the future to account for similarities and differences among the case studies we described and the situation at hand. The user has to provide for the necessary adaptations in the design of the process at hand and the application of the design components according to the presented situation, in order to make the model 'fit'. As such the model has to be considered as an action model rather than a descriptive model.

General limitations to this study

There are a number of general limitations and drawbacks to this study due to the way it was performed. This study started with the development of a theoretical framework for radical innovations, based on reflection on a number of streams in existing literature. As a consequence, our research project is positioned within a multiple theoretical background. Nevertheless, some streams of literature or elaborations on them (e.g. innovation literature that is based in manufacturing settings) were left out in order to focus the research project. This means that there is an inherent limitation to this study: the knowledge we collected on the subject is by definition limited to the streams of literature and related concepts we represented in our theoretical framework and by the structure we chose for this framework. Only part of the reality and truth concerning the process of radical innovation in KISFs can be seen through the 'looking glass' of our theoretical framework. *'Other findings may complement the ones presented here'* (Berends, 2003, p. 196).

Due to this eclectic approach towards our subject of study, we made an attempt to integrate theories in the fields of general innovation management (although limited), knowledge management, learning psychology and organizational behaviour (socio-political components of) and relate them to radical innovation in KISFs. Due to its qualitative and exploratory but structured approach, this study enabled us to explore new insights and concepts towards the creation of radical innovations in KISFs. We believe that this study succeeded in doing so. We were able to develop a process design model, to apply it, and to test and evaluate it. This approach has some drawbacks as well. This study does not contribute towards the testing of theory in this field. This holds especially for our own theoretical framework and especially for the process design model and its constituent components. These have only been marginally tested so far. Further testing still needs to be done.

11.3 ANSWERS TO THE RESEARCH QUESTIONS

On the basis of our total research project we want to generate answers to the research questions that we formulated for our study, while taking into account the limitations we mentioned in the preceding paragraph.

1. *What are the processes that lead to the creation of radical innovations in KISFs?*

Although we limited ourselves in the field of our study by considering only certain streams in the literature for the development and testing of our theoretical framework, we still feel that on the basis of our study we can discern the following processes for the creation of innovations in KISFs:

- a. *Learning processes* play a role especially in the first and last stages of the innovative process. The learning processes move from reflection on and conceptualization of externally acquired knowledge during the first stages of innovation towards a focus on processing of actual experiences in the primary process in the later stages. These experiences are placed within the new frame of reference that is created during the innovative process. There is a shift from a learning style based on experimentation on the basis of boundary spanning (acquisition of external knowledge) in order to develop new frames of reference in the first stages towards an application of knowledge in order to cater to continuous improvement within the new setting in the later stages. In the first stages of the innovative process the goal orientation is aimed at personal knowledge building, while in the later stages the aim is towards problem solving and the accomplishment of more clearly defined tasks.
- b. *Information processing activities* can be considered as essential for the creation of radical innovations. The acquisition of outside knowledge that lies beyond the currently used frame of reference is especially essential to offset for radical innovation process. Gatekeepers play a crucial role in the acquisition of this knowledge. In order to acquire external knowledge they have to participate in some way in external knowledge networks (that do not always have a formal status as such and may also consist of informal meetings with relevant others). The gatekeepers import new and deviating knowledge and perform the first interpretations, in order to form basic ideas for the new paradigm. During the innovation process the information processing activities change from acquisition and interpretation, in order to create basic ideas, towards interpretation in order to create a core concept, towards distribution of this core concept and application of experiences (available knowledge) within the context of the new frame of reference. During the last stages of radical innovation, which are focused on incremental innovation within the new context the emphasis is on knowledge application and distribution (of new insights).
- c. *Socio-political processes* play a role in the radical innovative process, and are especially crucial in the middle stages in the process, in which the basic ideas generated in the first stages are crystallized into reified core concepts that form the basis for the creation of actual innovative artefacts. In order to create this core concept (that forms a move away from the dominant paradigm and is the essence of the new paradigm that will be used), negotiations take place between the gatekeepers that bring in new and deviant ideas and boundary spanners that form a representation from the dominant coalition. These negotiation processes are geared towards agreement on the contents of the new frame of refer-

ence (is it radical enough and does it somehow fit in with the strategic challenges for the organization) and towards acceptance of the new frame of reference by the dominant coalition in the organization. It is exactly in these negotiation processes that the difference between uncommitted idea generation from relative 'outsiders' and the actual incorporation of a new paradigm by the crucial members of the KISF lies. In this process the radical innovation process gets enough posture to lead to actual (radical) innovative artefacts.

Apart from the three mentioned processes major determining factors for the creation of radical innovation are the different actors who play a role. Although the findings related to the different actors and the roles they play are still preliminary and are not yet thoroughly researched, we feel we can state that these actors and the roles they play are a major constituting factor in determining the creation of radical innovations (we will elaborate on this in answering the next question on the phases in innovation).

2. *What are the characteristics of the different phases in the creation of radical innovations in KISFs?*

In our study we found proof for the existence of three different phases in the creation of radical innovations. These phases are named by us according to the main characteristics of each phase: the idea generation phase, the crystallization phase and the evolution phase.

In terms of the *sequence of the phases*, we draw the conclusion that there is a need to finish a preceding phase in a satisfactory way before entering the next phase. It has to be checked if the innovative output of a phase is realized at an adequate level before the next phase can be properly started. The incomplete accomplishment of one phase may lead to serious problems in the innovative process later on. It is remarkable to note that in both unsuccessful cases the problem was not so much a lack of basic ideas in the idea generation phase but rather a lack of proper definition of an agreed core concept. Detrimental to the proceedings of radical innovation processes are:

- Prescriptive crystallizations: when core concepts are defined at the level of guidelines there is no room left for professionals in the organization to experiment with their own professional experiences and interpret knowledge within a new frame of reference. In socio-political terms prescriptive crystallizations will lead to non-compliance from opinion leaders from the dominant coalition, as they will feel enforced to participate in developments in the creation of which they had no influence
- Pseudo crystallizations: where there is no clear core concept, but a number of (related) concepts that form moving frameworks. In pseudo crystallizations it will be difficult to create commitment from opinion leaders in the dominant coalition and other professionals, since it is not clear on what this commitment is based. In pseudo crystallizations the frame of reference for the creation of 'aligned' actual innovative artefacts is lacking, pseudo crystallizations may lead to a number of innovations but not to a new and unifying concept that links these innovations into a more synergetic whole.

In terms of characteristics the phases can be described as follows:

- *Idea generation phase:*
 - Output are basic ideas for the underlying concept of the innovative process
 - Main constituting processes in this phase are the acquisition of new knowledge from external knowledge networks, reflection and conceptualization on this knowledge in relation to the innovative issue at hand, experimentation with new knowledge (in interaction with reflection and interaction). The basic ideas created in this phase are based on a drive towards knowledge building rather than towards problem solving in relation to the issue at hand.
 - Main actors in this phase are gatekeepers, who, often as peripheral members of the organization with access to external sources of knowledge (multi membership) are able to import this information into the organization. These gatekeepers may act as innovators (or in combination with innovators) in the interpretation of the knowledge and related learning processes and the creation of basic ideas.
 - Management plays a role in creating room for idea building by not focussing on (short term) outcome oriented performance measures for gatekeepers and innovators in this phase. This creation of room may consist of the facilitation of participation in knowledge networks and on the opportunity for knowledge building that is not goal oriented (reflection, conceptualization and experimentation). Next to this management should develop a strong strategic recognition capacity in terms of their ability to select both gatekeepers and ideas that will prove to be valuable for the strategic competition position of the organization. Organizational conditions for this restricted group of professionals should provide for this (e.g. in terms of temporary structures).

- *Crystallization phase:*
 - Output of this phase is a reified core concept that is agreed upon by both gatekeepers and opinion leaders from the dominant coalition of professionals (or by opinion leaders from relevant external parties).
 - Main constituting process in this phase is a socio-political process between gatekeepers and boundary spanners that is aimed towards the building and negotiation of a core concept that can function as a new paradigmatic frame of reference for the organization. After this core concept is created and agreed upon, the socio-political process is mainly steered by the group of boundary spanners and seeks a re-interpretation of experiences in the primary process within the context of this new frame of reference.
 - Major actors in this phase are at first gatekeepers and boundary spanners who form and negotiate the core concept. Both parties can have differing interests in this, gatekeepers tending to farfetched ideas, boundary spanners tending towards confirmation of the ideas in accordance with existing views within the dominant coalition. This forms the basis for the negotiation process.
 - Senior management plays a role in this phase by identifying boundary spanners who are capable of handling the split between radical innovation and acceptance by the dominant coalition. They may also play a role in influencing the 'degree' of radicality of the innovation on the basis of their strategic recognition capacity. In

these terms they may play a role in the negotiation processes between gatekeepers and boundary spanners, influencing the outcomes of the process.

- *Evolution phase:*
 - Output of this phase is a continuous stream of innovative artefacts that fits in with the core concept/new frame of reference
 - Major processes comprise the processing of knowledge in order to create continuous improvements and innovations: distribution of new insights that are formed by placing experiences in the primary process in the new framework and the application of these insights in order to realize actual innovations. In order to create these innovations the information processing activities are combined with learning activities focused on continuous improvement and the processing of experiences aimed towards the solution of actual problems and the completion of tasks.
 - Major actors in this phase are boundary spanners who now act as the ambassadors for the core concept and new frame of reference. They act as a group of early adopters and opinion leaders who are critical for the acceptance of the ideas by the majority of the professionals in the organization. Other major actors are the professionals who develop the actual innovations in relation to the execution of the primary process.
 - The role of management focuses on the creation of an environment in which continuous improvement can take place: a structure and a culture that provide knowledge sharing and 'small scale experimentation'.

3. *What are the organizational conditions that facilitate the creation of radical innovation?*

Although this aspect was not explicitly included in the research, it can be deduced from the findings that organizational conditions and a facilitating role for management certainly has an influence on the creation of radical innovations. The characteristics of the conditions and managerial role are represented in the description of the three phases.

4. *Can the process of creating radical innovations be influenced by adequate application of the process design model for radical innovations?*

It becomes clear from the second part of our research project that adequate application of the process design components in innovation processes, does lead to better results in terms of radical innovations as compared to innovative processes where the practical design components were not or not adequately applied (the unsuccessful cases). As such it can be concluded that proper application of the model and its constituent design components may contribute to the creation of radical innovations. This finding was emphasized by the fact that application of our model in the case study pharmacy was inadequate the first time round; this led to detrimental effects on the outcomes of the innovative process. Correction of this and a proper application of the practical design components the second time led to the proposed positive effects on the innovative process and subsequently to a successful and radical innovation.

On the basis of our findings and the conclusions, we feel that a more concise presentation of the process design model is necessary. This more concise presentation means that there is a need to a focus on:

- Role of networks, information processing and learning processes in the idea generation phase.
- Socio-political processes in the crystallization phase.
- Information and learning processes and 'embedding structures and processes' in the evolution phase.
- The role of the different actors in the different phases.
- A more explicit role for management in the process.

These aspects are discussed in our last chapter.

12. DISCUSSION: A REFINED DESIGN MODEL FOR RADICAL INNOVATIONS IN KISFS

In this last chapter we present our refined model for the creation of radical innovations in KISFs. The model is based on the empirical findings of our research project and the intermittent theoretical reflections upon these findings. In our empirical research we aimed at the development and testing of the model, by descriptive research of four cases and prescriptive application in one case. In this chapter we discuss our model in the context of the theoretical framework and we enrich it further by linking it both to the general field of change management and to the field of 'knowledge economics'. The link to change management enables us to see our model as a 'form of change management', thereby providing more insights in how to effectively handle the process of radical innovation. The link to knowledge economics is a revisit of the discussion in chapter 1 on the strategic value of innovations for KISFs. We elaborate on this discussion by analyzing the strategic added value of the separate phases that constitute the total innovative process. This may help management consider the return on investment on each of these phases and thus decide upon its strategic need and value.

We start with a short summary of our refined process design model for radical innovation (12.1). We relate our model for innovation in KISFs to innovation in general (12.2), and then we relate our model to change management and knowledge economics (12.3). Later we provide a discussion of the different constituting parts of the model aimed at a better understanding and use of the model and the guidelines (12.4). We end this chapter with suggestions for further research (12.5).

12.1 REFINED PROCESS DESIGN MODEL FOR RADICAL INNOVATIONS IN KISFS I

Our process design model for radical innovations can be described in terms of three main dimensions:

- The *phases* of the innovative process, which can be described as:
 - Idea generation.
 - Crystallization.
 - Evolution.
- The *underlying processes*, which constitute the total innovative process:
 - Learning processes.
 - Information processing.
 - Socio-political processes.
- The *actors* who play a key role in the different phases:
 - Gate keepers/innovators.
 - Boundary spanners.
 - Executing knowledge workers.

Next to these three dimensions, there is a separate dimension that is essentially conditional to the creation of radical innovations. This dimension is related to:

- The *role of management and organizational conditions*.

The process design model consists of a number of practical design components that may serve as heuristic guidelines for the creation of radical innovations in KISFs. The practical design components can be categorized on the basis of the four dimensions. A summarized description of the design components is given in table 12.1. In paragraph 12.4 guidelines for application of the process design model are given on the basis of an elaborate description and discussion of each design component.

Phase	Idea generation →	Crystalization →	Evolution
Processes: <ul style="list-style-type: none"> ▪ Learning ▪ Information processing ▪ Socio-political 	<i>Information processing:</i> <ul style="list-style-type: none"> ▪ Connection to external knowledge networks ▪ Acquisition and importation of external knowledge <i>Learning:</i> <ul style="list-style-type: none"> ▪ Boundary spanning and experimenting ▪ Reflection and conceptualization ▪ Personal knowledge building 	<i>Socio-political processes:</i> <ul style="list-style-type: none"> ▪ Identification of opinion leaders with strong informal position (boundary spanners) ▪ Linking gatekeepers to boundary spanners <ul style="list-style-type: none"> ▪ Creation of open political processes: <ul style="list-style-type: none"> ○ Collective knowledge interpretation ○ Negotiation on ideas and concepts <i>Information processing:</i> <ul style="list-style-type: none"> ▪ Collective creation of a core concept 	<i>Information processing:</i> <ul style="list-style-type: none"> ▪ Distribution of core concept as new frame of reference ▪ Application of professional knowledge within new frame of reference <i>Learning:</i> <ul style="list-style-type: none"> ▪ Sharing and processing of experiences within new frame of reference ▪ Continuous improvement ▪ Problem solving/task oriented
Actor	Gate keeper Innovator	Gate keeper/innovator Boundary spanners	Boundary spanners Executing knowledge workers
Management and Organizational conditions	<i>Strategic recognition:</i> <ul style="list-style-type: none"> ▪ Identify gate keepers ▪ Support participation in external knowledge networks and knowledge acquisition ▪ Support knowledge building learning styles ▪ Identify valuable ideas ▪ Accept long term returns 	<i>Absorptive capacity:</i> <ul style="list-style-type: none"> ▪ Identify boundary spanners ▪ Manage collective knowledge interpretation ▪ Manage negotiation between boundary spanners – gate keepers ▪ Confirm core concept 	<i>Incremental innovation:</i> <ul style="list-style-type: none"> ▪ Create small project teams for application and implementation ▪ Engage boundary spanners and implementing professionals ▪ Confirm core concept as new strategic framework ▪ Create a structure and culture for learning and continuous incremental innovation
Output	<ul style="list-style-type: none"> ▪ Basic ideas 	<ul style="list-style-type: none"> ▪ Agreed core concept 	<ul style="list-style-type: none"> ▪ Innovative artefacts ▪ Continuous incremental innovation

Table 12.1: Practical design components for radical innovation

12.2 INNOVATION IN KISFS AND INNOVATION IN GENERAL

12.2.1 Relevance of general innovation theories for KISFs

In chapter two we discussed the relevance of general innovation for radical innovation in KISFs. On the basis of our final model we want to add some remarks on this relevance. Our test of the process design model confirms our statement that the view of radical innovation in KISFs, as the total sum of a number of continuous incremental innovations (Robinson and Stern, 1997; Coombs 1999), is not valid. In this sense our research is in line with recent research on innovation in service firms that state that the dominant mode for innovations in these firms is not client-led in terms of continuous problem solving on client-demand, but is a separate autonomous function sparked off by (strategic) processes in the service firm itself (Sundbo, 1997; den Hertog et al, 2003). In this sense KISFs may function on the basis of *autonomous* as well as *induced strategic behaviour* (Burgelman, 1983). As a consequence there may be more overlap between radical innovation processes in KISFs and in manufacturing industry, making insights from radical innovation in manufacturing more relevant for the creation of radical innovations in KISFs. However, it has to be taken into account that besides the overlap there are also some significant differences (as was stressed in the testing of our model):

- In manufacturing the idea generation phase often takes place in a separate R&D setting. In KISFs the idea generation phase is a separate stage with characteristics that differ strongly from incremental innovation in ongoing primary processes. We do not, however, want to argue for the creation of separate R&D departments in KISFs. In general, idea building (R&D) in KISFs may well demand different knowledge networks, gate keepers and innovators for each innovation process. The permanence of R&D departments may prove to be too static for the fast variation in knowledge developments and knowledge trends in KISFs. At the same time innovation in KISFs seems to be based more on ideas than scientifically based. In general, the theoretical models of R&D organizations have little relevance to KISFs (Sundbo, 1997). On the basis of our findings we want to argue instead for the creation of a portfolio of flexible and virtual R&D networks for KISFs. We will elaborate on this in paragraph 12.3.1.
- There is a much stronger role for socio-political processes in radical innovation in KISFs than in manufacturing industries. This is strongly confirmed in the case where we tested our model and where the initial neglect of political processes nearly led to the abolishment of the innovation process. This means that innovation in KISFs demands explicit room for an emphasis on the political processes that are necessary for collective knowledge interpretation and negotiation of core concepts (the crystallization phase). We find support for this in other work on innovation in services (Sundbo, 1997). We elaborate on this in paragraph 12.3.2.
- The innovative process in KISFs does not end with prototype-creation and testing and subsequent production-processes. For innovation in KISFs the actual realization of the innovative process lies in a final (and continuous) evolutionary phase. In this phase the implementing professionals realize the innovation by implementing it in their daily work and by creating improvements in the process of service delivery. Due to this, innovation in KISFs has strong implications for all members of the organization and has a major impact on the whole of the primary process. This induces both active involvement of all professionals in the process and the mission for management to create a structure and cul-

ture that stimulates continuous incremental innovation by the executing professionals (Muller, 2004). We elaborate on this in paragraph 12.3.3.

- Instead of a strong role for top management in the instigation of radical innovation processes in manufacturing, the emphasis for the start of the innovative processes in KISFs may also lie in the hands of professionals. In KISFs the role of management is focussed on strategic recognition capacity, creation of absorptive capacity, and the general support of the innovative process rather than on a central and active role in the generation of autonomous strategies. We elaborate on this in paragraph 12.3.4.

12.2.2 Relevance of the process design model for other types of organizations

On the basis of our research project we do not want to question only the relevance of general innovation theories for KISFs, we also want to relate our innovation model for KISFs to innovation in organizations in general. In other words, is our process design model for radical innovations in KISFs also valid for other types of organizations?

Central to this issue in our view are the type of innovation and type of innovation process we researched and the relevance of these two items to innovation in general. Apart from the degree of radicality of the innovation we researched, the innovations we researched are strongly characterized by the fact that they are conceptual and ‘software-like’ in character rather than concrete and ‘hardware-like’. The type of innovation process we researched is characterized both by the fact that it concerns conceptual and software-like innovations and by the fact that there is a high degree of socio-political influence on the innovation process. This may mean that the findings from our research apply to innovation processes that concern conceptual and software-like innovations in settings that are strongly socio-political in character. In relation to what we stated on the socio-political processes in chapter two, the socio-political character is related to settings with (a) a limited direct influence of management on the direction of the innovation process and a high degree of autonomous strategic behaviour for workers in the primary process, (b) a strong degree of autonomy for workers in determining the proceedings and output of the primary process and (c) the emergence of strong negotiations between different coalitions of workers in the primary process in reaction to the introduction of new concepts. This description of a socio-political process may apply in our view to all types of organizations or parts of organizations, where knowledge workers, who develop ideas and concepts, form the majority of the workforce. Keeping in mind the remarks about the limitations of this study (paragraph 11.3), this means that our process design model for radical innovations has a wider area of relevance than KISFs alone. The model is relevant for those types of organizations or parts of organizations where knowledge workers form the majority of the workforce and where the primary process concerns conceptual and software processing rather than product and hardware processing. Examples of these are policy producing (government) agencies, R&D-organizations and departments, health care institutions where processing of high level knowledge is part of the primary processes (e.g. hospitals) and software developers.

12.2.3 Relevance of the process design model for other types of innovations

As stated in the last paragraph, the process design model is related only to conceptual, software-related innovation. This means that the model is not related to product innovation or new prod-

uct development (NPD) or to architectural innovations, in which reconfigurations in hardware systems are the main subject (e.g. process technology settings). There may be a degree of relevance to reconfigurations of architecture in software systems, since these may concern a radical shift in the primary process delivered by knowledge workers (major architectural shifts in KISFs often concern a combination of reconfiguration of existing concepts and methods, and introduction of new concepts and methods).

In terms of degree of radicality, we stated in chapter one that the dichotomy between incremental and radical innovations (with strategic innovations showing a middle-of-the-road status) was too simple; yet it provided a good starting point for our research. Although different taxonomies for innovation have been produced in recent years (e.g. Den Hertog, 2003; Sundbo, 1997), we still feel that the dichotomy between incremental and radical innovations is both relevant in terms of its effect on sustainable competitiveness and in terms of differences in underlying processes: radical and incremental innovations are based on different processes and have different effects on the sustainable strategic competitiveness of the firm. Our research study and the process design model we developed focussed on the creation and effects of radical rather than incremental innovations.

Although there is a distinction between incremental and radical innovations, there is no such thing as radical innovation as one single state of being: in this study we researched radical innovations, but some were more radical (and some less radical). In general, there is no clear distinction between radical and strategic innovations. The innovations we researched concerned discontinuities in line (radical innovations) but were also characterized by fundamental renewals and new combinations of concepts and technologies (strategic). Consequently we can conclude that application of the process design model relates both to strategic and radical innovations and to the continuum between them. In terms of the contingency between the type of firm and level of innovation, where radical innovations are considered to be relevant to experience firms and expertise firms rely more on strategic innovations, we feel that our model is relevant to innovations in both experience- and expertise-based firms.

12.3 INNOVATION, CHANGE MANAGEMENT AND KNOWLEDGE ECONOMIES

12.3.1 Innovation as change management

On the basis of the characteristics of our final process model we want to ask the question to what extent innovation processes are comparable to general change processes. Similarity of the processes allows for the possibility of applying general principles of change management to the management of innovation processes, thereby enlarging the scope of practical guidelines available for the innovative process.

On the basis of a comparison between the elements of change processes and the constituent elements of our model, we conclude that there is a certain similarity between more general change processes and the process of radical innovation. Compare for instance the description of planned change that De Caluwé and Vermaak (1999) give with the elements in our model (in non-italics):

'change is...

- *realizing the outcome you planned* (innovation output)
- *as a function of the cause, context, philosophy* (cause for innovation and developments within the internal and external environment)
- *by means of a game of influence by actors* (socio-political process and actors)
- *by going through a course in different phases* (phases)
- *by communicating and giving meaning* (which may be related to some extent to learning and information processing)
- *where the whole process is managed by conscious interventions from change agents'* (management and organizational conditions) (De Caluwé and Vermaak, 1999, p. 72).

Similarities between change management in general and our process model also become clear by comparing the different phases described by a number of researchers:

Model	Process		
Lewin (1947)	Unfreeze	Move	Refreeze
Moss Kanter (1983)	Departures from tradition and crises	Strategic decisions and prime movers	Action vehicles and Institutionalization
Nadler and Tushman (1989)	Energizing	Envisioning	Enabling
Van Poucke (2004)	Idea generation	Crystallization	Evolution

Table 12.2: Phases in change processes and in innovation

Apart from the similarities there are, however, also a number of significant differences. The main difference lies in the fact that whereas change processes are 'general' and can relate to all sorts of subjects and objects (e.g. production systems, staff development, culture, structure, product and services), the type of innovation processes we treat in this context are related to change regarding the renewal of primary processes or services. As such we consider innovation as a separate category of a general class of (change) processes, with a large similarity between change processes and innovation processes, but also a number of differences. These differences are related mainly to the contents of the change process and as such to the influence of external knowledge, processes of learning and information processing, the related actors and the subsequent output. As a consequence there are differences between the first and the last phase of the process:

- In the first phase there is in radical innovation a strong emphasis on external knowledge acquisition, conceptualization and experimentation and on personal knowledge building, whereas general change processes may have more emphasis on learning for problem-solving than on learning for concept-building and may have a stronger relation to the use of already defined strategies, internal knowledge and insights.
- In the last phase there may be a tendency for change processes to be more static ('re-freeze', 'institutionalization'), whereas in innovation the last phase is a dynamical one with a focus on continuous improvement and innovation by professionals. The process is

not finished in this phase but moves on within the chosen frame of reference (it has to be remarked that increasingly approaches towards change see the final phase not as static but as a phase of continuous adaptation and change processes).

Still we feel that insights from change management can be used in innovation process management, as long as we account for these differences.

In studying a number of approaches towards change, we feel that the 'colours of change' approach as developed by de Caluwé and Vermaak (1999) is a useful approach for innovation as change. It provides the semantics and tools to incorporate characteristics of a general change process within the innovative process. The 'colours of change' approach was developed to describe different attitudes and subsequent methodologies for change (different types of interventions and change agents). De Caluwé and Vermaak distinguish five different ways to approach change and relate them to different colours:

- Yellow: in which change is a socio-political process that is realized by negotiation among different conflicting parties, positions and interests, by the realization of win-win-situations and by the creation of support from different coalitions. The realized change is the outcome of the socio-political processes that take place.
- Blue: in which change is a rational and logical process that is realized by planning and organizing. The output of the change process is measurable and defined and agreed upon beforehand. The realized change is the outcome of a strictly planned and managed process.
- Red: in which change is a change of the 'soft' elements in the organization, such as style of management, staff and competences. Change is realized by using HRM-instruments and is created in interaction between change agents and the persons that are 'subjected' to the change process.
- Green: in which change is coupled to learning and learning outcomes that are realized by learning processes (feedback loops, experimentation) and by motivating people. Change is the result of the collective learning outcomes.
- White: in which not the output but the process of change itself is a goal. Change cannot be imposed from outside but is only possible as a self chosen, autonomous process. Change cannot be managed but can be facilitated by removing barriers for change and possibly by intervening in change patterns that take place. Change is a dynamic and complex process. Change is non-linear, dynamic, can be experimental and tends to be meta-paradigmatic.

Although the colours are intended to describe ways of thinking about change and interventions, and thus provide a subjective, actor-related description, we feel that the colours describe not only views on change, but can also be used to describe the character of the change process itself. In other words, besides to the subject-related description of change, the approach can also be used for an object and process-related description of change. In doing this we can turn the approach into a contingency model with a contingency between the character of the change process at hand and the character of the change agent and his or her interventions. This is in line with literature that describes the relation between the type of intervention and its effect (de Leeuw, 2000): the effectiveness of different interventions is strongly influenced by the match between

the character of the situation and the character of the intervention. From this line of reasoning we conclude that we may be more effective in mastering the management of the innovative process, when we are able to typify the character of the change process and create a match with the corresponding type of interventions.

The character of the different phases in the process design model shows a predominant (but not total!) resemblance to three colours:

- *Idea generation: white*, as the process of idea generation is indeed non-linear, dynamic, experimental and is aimed towards changes in paradigm (and thus meta-paradigmatic). In our view the 'white description' provides a way to incorporate the innovation process characteristic of external knowledge sourcing as an essential element in the general change process.
- *Crystallization: yellow*: as there is a strong stress on socio-political processes in this phase of the innovation process, in which different actors, coalitions and their interests and the negotiations that take place have a dominant role in influencing the actual outcomes of the innovative process.
- *Incremental innovation: green* as the creation of actual innovations is a process in which continuous learning and improvement in the context of the new frame of reference take place and outcomes are determined by these learning processes (and where there is room for a continuous and dynamic incremental innovation process).

The effectiveness and efficiency of the innovative process can be improved by encouraging a match between the predominant colour as described for each phase and the interventions and actions belonging to that colour. For example the idea generation phase will benefit from interventions like networking, creating dialogue and brainstorm sessions (white interventions) and will suffer from interventions like detailed management by objectives, project-planning and auditing (blue interventions). Describing the phases in terms of colours may provide a framework for choosing interventions and steering the proceedings and management of the innovative process.

In addition to our formal empirical research, we tested and used the match between the colours of phases and the colours of change managers and interventions in several sessions with managers and other actors who played a role in innovation processes. Managers scored themselves by means of a questionnaire in terms of a dominant colour (both in thinking and acting). On the basis of these scores, their experiences as innovation-process managers were discussed. In general it appeared that the colour-assessment provided valuable insights into their strengths and weaknesses as process managers for innovation in the different phases. We feel therefore that the colour-model of change can provide a valuable addition to our process design model, since it may help us further in understanding the process and in designing and selecting possible interventions for each phase.

12.3.2 Innovation as knowledge economics: strategic competitiveness

In order to evaluate our process design model for radical innovation in terms of its contribution towards knowledge economics we base our analysis on the recent work of Max Boisot (1998).

Boisot describes the process of knowledge creation on the basis of the Social Learning Curve where learning takes place in I-space (Information-space). To define the I-space Boisot describes information in terms of three dichotomies: ‘uncodified-codified’; ‘concrete-abstract’; and ‘undiffused - diffused’. This description is in line with several other descriptions in literature (e.g. Nonaka’s and Takeuchi’s (1995) description of knowledge alongside the dichotomy tacit - explicit and individual-collective). According to Boisot, information is processed and knowledge is created within the I-space by S-learning (‘Schumpeterian learning’) according to the social learning curve as depicted in figure 12.1.

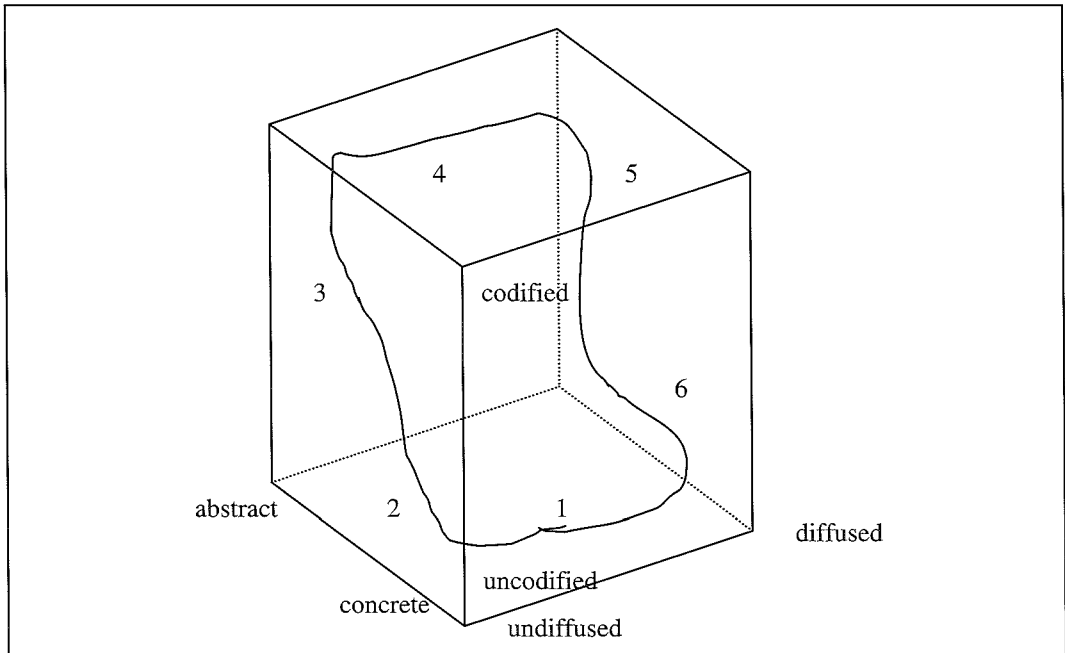


Figure 12.1: Boisot's Social Learning Curve

In Boisot's view knowledge creation takes place in a learning process in which knowledge is transformed and created in consecutive phases. These phases are described as:

1. *Scanning: identifying threats and opportunities in generally available but often fuzzy data. Scanning, patterns such data into unique or idiosyncratic insights that then become the possession of individuals or small groups.*
2. *Problem-solving: giving structure and coherence to such insights-i.e. codifying them.*
3. *Abstraction: Generalizing the application of newly codified insights into a wider range of situations reducing them to their most essential features-i.e., conceptualizing them. Problem-solving and abstraction often work in tandem.*
4. *Diffusion: sharing the newly created insights [well-codified and abstract] with a target population.*
5. *Absorption: applying the newly codified insights to different situations in a 'learning-by-doing' or a 'learning-by-using' fashion.*

6. *Impacting: the embedding of abstract knowledge in concrete practices .. absorption and impacting often work in tandem* (Boisot, 1998, pp. 59-61).

There is a strong parallel in the phases and processes as described by Boisot and the phases and processes we developed in our model:

- Scanning and the tandem of problem-solving and abstraction are very similar to our phase of idea generation as patterns for new paradigms are developed and codification and conceptualization take place; knowledge is still undiffused.
- Abstraction and diffusion are comparable to our crystallization phase; abstraction and codification of basic ideas is increased; a first start with diffusion is made.
- Later stages of diffusion and the tandem of absorption and impacting are a description of our evolution phase; abstract and codified knowledge is diffused in the process of application and is transformed into concrete and uncoded knowledge.

On the basis of the dichotomies in the I-space, and the position of knowledge in all three dimensions, Boisot draws up a value map for knowledge assets:

- Its position on the dimension of diffusion reflects the scarcity of knowledge: the further it is on the left, the less it is shared by a population and thus the scarcer it is, and vice versa.
- Its position on the dimension of codification and abstraction reflects the utility of knowledge: information that is abstract and codified will have many different potentially useful applications (as abstraction increases the degree in which it can be generalized to a number of situations and codification increases the degree of articulation and standardization¹), the more abstract and codified knowledge is the higher its utility.

In these terms knowledge has its maximum value (V-max: maximum scarcity and utility) whenever diffusion is at a minimum and codification and abstraction are at a maximum, and vice versa (V-min).

In addition to the concept of value, we want to introduce the concept of return-on-value as the capacity to actually capitalize on the value of created knowledge. As we found in our research, the creation of new concepts (high in abstraction and codification, low in diffusion) does not always lead to innovations that are actually implemented. The political ability to negotiate meaning and create alignment and engagement on the new concept, and therefore the ability to diffuse the concept to relevant others, is *essential for the actual potential of realization of radical innovations*. Highly abstract and codified concepts that are diffused and accepted by influential knowledge workers pose maximal potential for capitalization of innovative ideas (C-max). From the findings of the unsuccessful cases we can conclude that both abstraction and codification (Social Sciences case) and diffusion in terms of alignment and engagement (Lite City case) are preliminary to capitalization on innovative ideas. Consequently we want to state that next to V-

¹ An example of this comes from our case Pharmacy. Initially detailed, but vague, educational principles were used as a concept for innovation. These principles proved to have little applicability for a wide range of situations and led to ambiguity and conflict. Replacement of these principles by the more abstract but sharp concept of CIA (Concentric, Integrated and Activating) proved to be much more valuable in terms of comprehension, range of application and usefulness.

max and V-min there is also C-max (maximum potential capitalization) and C-min (minimum potential capitalization). C-max is reached whenever knowledge is ready to be provided and applied to clients: at the stage where it is diffused (read 'accepted') and ready to be translated from abstract to concrete and codified to uncoded. In our view this moment is reached when the core concept stands out as a reified framework for the actual innovations: at the end of the crystallization phase and the start of the evolution phase. C-min is reached when knowledge is 'milked out': undiffused, concrete and uncoded (and out of line with new emerging paradigms). This marks the end of the evolution phase and the start of a new cycle of radical innovation. When we represent the concepts of Value and Capitalization in the I-space and in relation to the Social Learning Curve (and our own process design model), the following picture arises:

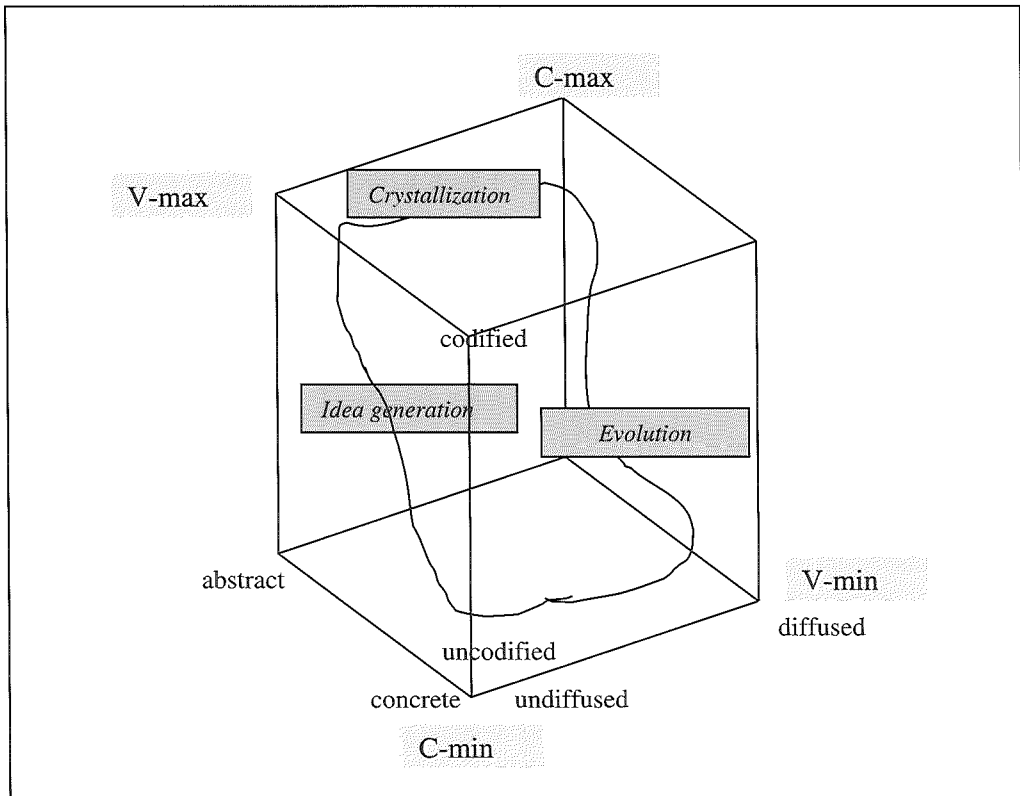


Figure 12.2: Process design model and knowledge value and capitalization

This model provides the basis for an economic analysis of the process design model in terms of the creation of knowledge assets. We conclude that:

- The idea generation phase provides maximum asset growth in terms of *value creation* leading to *V-max*.
- The crystallization and the start of the evolution phase create maximum asset in terms of *capital creation* leading to *C-max*.

- Further progress of the evolution phase leads to *value destruction* (and in case of ‘unchanged policies’ in the near future to *capital destruction*) leading respectively to *V-min* and *C-min*.
- The start of a new cycle of radical innovation, by starting a new idea generation phase, will lead to *initial capital destruction*, but in the longer term to *renewed value creation*.

The initial capital destruction in the idea generation phase is caused by the retraction of gate keepers and innovators from the primary process and the investments in the creation of external knowledge networks and ‘innovation sites’ (the virtual R&D network and -site). However, when the viewpoint is taken that radical innovations are essentially competence destroying (Schumpeter, 1961; Tushman and Anderson, 1986), the onset of a new cycle of radical innovation becomes strongly capital-destroying as actual primary processes become obsolete. This type of competence-destroying innovation may be relevant to production settings, where creation of new products demands the destruction of old and creation of new product lines. We feel, however, that destruction of existing intellectual and social capital as a consequence of radical innovation, is not an option for KISFs. Radical innovation in this sense would in effect mean destruction of the original KISF and its most valuable assets. Rather than leading to capital destruction, radical innovation and the innovative process should be shaped in a way in which existing social and intellectual capital can be remoulded into new strategically valuable assets that are in line with the innovative concept. In this way radical innovation is capital enriching rather than capital destroying. To realize competence-enriching innovation, emphasis should be given to the importance of reframing experiences and competences in the context of the new paradigm, during the evolution phase. In the evolution phase the accent has to lie on reframing and remoulding experiences and competences and on aligning these with innovation, rather than on making existing competences obsolete. When the radical innovative process is steered in this direction, it causes minor capital destruction (retraction of gatekeepers and innovators from the primary process) and is in the long run capital enriching rather than fundamentally capital destroying.

For top management our economic analysis infers that they have an important role in monitoring innovative processes and asset creation and destruction in their organization. It is their task to organize a ‘radical innovation cycle’ that is tuned to the movements in asset creation and destruction:

- Top management has to manage the rhythm between exploitation (evolution phase with a stress on incremental innovation) and exploration (idea generation phase).
- Top management has to manage the ratio between value creation and capital destruction, catering for maximal value creation and capital enrichment rather than capital destruction.

In line with our economic analysis, we can conclude that the learning processes that take place in the idea generation phase have a strong role in value creation. In line with this we want to refer to these learning processes (knowledge acquisition, reflection and conceptualization, experimentation and personal knowledge building) as ‘*fast learning*’. The learning processes that take place in the evolution phase are in the longer run value destroying but have a role (certainly at first) in capital creation. This means that they are in essence less rich in output than learning processes in the idea generation phase. In line with this we want to refer to these learning proc-

esses (knowledge distribution and application, continuous improvement, use of experiences and problem solving) as ‘slow learning’.

12.3.3 Final process design model for radical innovation in KISFs II

When we combine the phases, processes and actors and the findings from the discussion on change processes and knowledge economies into our process design model, we can conceptualize our final model (figure 12.3):

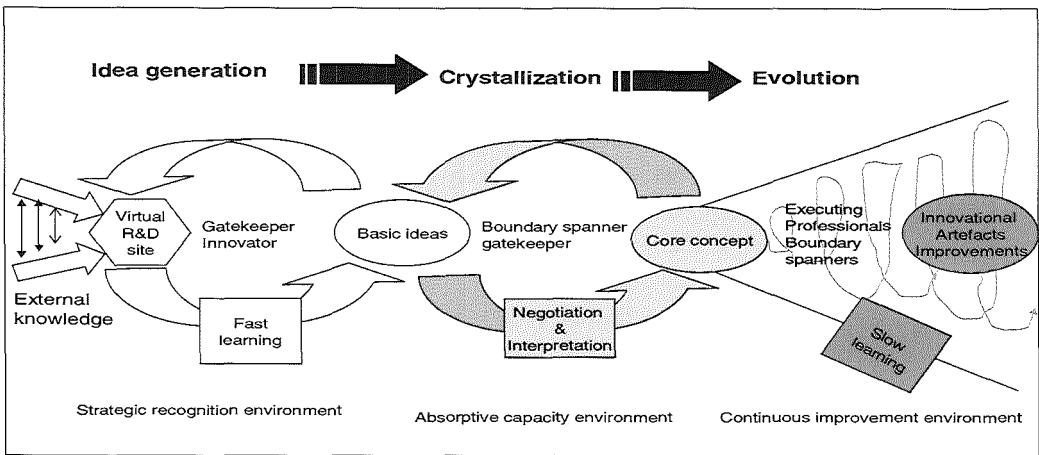


Figure 12.3: A process design model for radical innovation in KISFs

In the next paragraph we discuss the application of the constituent elements of the model on the basis of our empirical research and in the light of the most relevant literature.

12.4 DESIGNING FOR RADICAL INNOVATIONS: APPLYING THE MODEL

12.4.1 Idea generation

Phase	Idea generation
Main processes	Information processing: Knowledge acquisition Learning: Fast Learning
Actors	Gate keepers Innovators
Management and Organizational conditions	Strategic recognition capacity External knowledge network (virtual R&D network and –site)
Output	Basic ideas

The idea generation phase has the function of creating basic ideas that comprise the essence of the actual creation of radical innovation. Essential elements of the idea generation phase are:

A. External knowledge network (virtual R&D-network)

Goal	To create a 'source and site' where new information is acquired, new knowledge is created, and basic ideas for new paradigms/radical innovations are developed
Design guidelines	<ul style="list-style-type: none">▪ Virtual R&D-networks and –sites are created by professionals themselves (gate keepers/innovators)▪ A central position for gate keepers/innovators in the virtual R&D-network improves access to knowledge▪ Rich virtual R&D-networks are cross-functional and go across organizational and technological boundaries▪ Rich networks connect widely dispersed sources of knowledge▪ Interpersonal trusts and stable ties improve the conditions for fast learning in the virtual R&D-network▪ Loose ties create new and destabilizing insights▪ Exchange is positively influenced by open political processes (power-equality, investigation, dialogue)▪ Participation in networks needs to be accepted and facilitated rather than directed▪ Strategic valuable alliances are created by gate keepers and innovators (management has an evaluating and facilitating role)
Output	Information and knowledge acquired from outside Newly created knowledge Basic ideas for new paradigms/radical innovations

Explanation and background

Both our research results and recent research and literature point to the growing importance of external knowledge networks for innovation in general and to the importance of knowledge networks for innovation in (knowledge-intensive) service firms. Permanent R&D departments play no significant role in the development of innovations for service firms (Sundbo, 1997). In our cases all successful radical innovations are based on rich outside knowledge sourcing from external knowledge networks. Gate keepers and innovators are the knowledge sourcers.

The network has the function of exchange of information and knowledge, knowledge acquisition, collective knowledge creation, and the origination of basic ideas for new paradigms and radical innovations. It functions as a 'virtual R&D-network and virtual R&D-site' that replaces the classical R&D-department. In all our cases the networks are created by gate keepers/innovators on their own initiative. Management does not have a directive role in this. Thus, strategic alliances are essential to radical innovations, but the formation of these strategic alliances lies in the hands of professionals rather than of management. This asks for the decentralization and loosening up of the formation of 'strategic R&D-alliances'.

The quality of input from the network is determined by:

- The centrality of the participating gate keeper and innovator in the network (Eisenhardt and Santos, 2002).
- The cross-functionality and multi-disciplinarity of the network leading to destabilizing insights (Boisot, 1998; Dougherty, 1990).
- The degree in which the network extends beyond currently existing networks, i.e. expands existing organizational and technology boundaries (Rosenkopf and Nerkar, 1999; O'Connor and McDermott, 2004).
- Connection of widely dispersed sources of knowledge (Newell et al., 2002).
- Interpersonal trust that stimulates the creation of social capital as a result of knowledge sharing and collective experimentation (Nahapiet and Ghoshal, 1998).
- Loose ties and hop-and-skip links that stimulate speed, amount and diversity of knowledge exchange (Hansen, 1999).
- Open political processes (power-equality, investigation, dialogue) that positively influence knowledge exchange and development.

Further readings

- Kogut (2000) describes organizations in terms of a Knowledge Based View (KBV) and stresses the importance of social networks for the creation of new knowledge in the organization.
- Brown and Eisenhardt (1995) describe three main streams in product development in diverse industries and discuss the approach of product development as a communication web.
- Nahapiet and Ghoshal (1998) evaluate the factors leading to the development and creation of social capital, in which social capital is considered as the output of a process of the combination and creation of knowledge in knowledge networks.
- Hansen (1999) describes the search-transfer problem in networks and evaluates the function and effect of strong and weak ties in the social network.

B. Gate keepers and innovators

Goal	Identification of gate keepers and innovators and the creation of conditions for idea generation
Design guidelines	<ul style="list-style-type: none"> ▪ Identify gate keeper and innovator on the basis of their characteristics (see explanation) ▪ Role of gate keeper and innovator can be combined ▪ Check abilities of gate keepers and innovators or stimulate development of necessary abilities (see explanation) ▪ Trade capital creation for value creation and accept capital destruction for gate keepers and innovators ▪ Create virtual R&D-site for gate keepers and innovators ▪ Provide gate keepers and innovators with informal support for their activities ▪ Protection of gate keepers/innovators and their ideas by (top) management
Output	<p>Capable gate keepers and innovators</p> <p>Room for idea generation for gate keepers and innovators</p>

Explanation and background

Gate keeper and innovator are the key roles in the idea generation phase. Gate keepers are 'individuals who have multi membership in both the KISF and relevant external knowledge networks, and who perform the act of acquisition and first interpretation of knowledge'. Innovators are 'individuals with a strong associative fluency (Guildford, 1959) as the ability to produce a variety of ideas related in a specific way to a given idea'. The two roles may be located in different persons, but in our research they are either united in one person or united in different subjects in different group members.

Gate keepers and innovators can be quickly recognized as they often 'stand out from the lot'. Management can recognize them by a number of characteristics: natural explorers and experimenters with no predisposition for exploitation of knowledge; a strong tendency towards personal knowledge building; critical of ongoing (routine) practices; thrive by personal contacts especially those outside the organization; commitment to more than one discipline; independent and motivated by challenges (Raelin, 1991; Hausschildt and Schewe, 2000, O'Connors and McDermott, 2004).

The role of gate keepers and innovators in the innovative process entails the acquisition of new (destabilizing) information, knowledge sharing and idea generation. To perform this role, they have to possess a number of capabilities (from gate keeping to innovative):

- Strong interpersonal and communicative abilities.
- Ability to combine knowledge from multiple sources and with a multidisciplinary character (Cohen and Levinthal, 1990; Leonard-Barton, 1995).
- Strong cognitive skills to combine multidisciplinary data sets (Newell et al., 2002).
- Ability to spot promising new patterns in information (demanding a broad strategic vision of the knowledge field).
- Ability to create structure and coherence in data (Boisot, 1998).
- Ability for conceptualization.
- Associative fluency (Guildford, 1959; Amabile, 2002).

The activities of gate keepers and innovators differ strongly from activities in the general primary process. This demands a 'virtual R&D-site' providing time and space for these activities. Creation of this site requires management to facilitate activities that are 'capital-destroying' but 'value creating'.

As a consequence both of their multi membership and a tendency to propose destabilizing ideas, gate keepers/innovators are considered as peripheral members of the organizational community and are often not fully accepted (Wenger, 1998; Boisot, 1998). Their ideas are often rejected and need protection. This has to be provided by top management and boundary spanners. An exception to this are firms where founders/owners play the role of gate keepers/innovators. These have a strong core position and can initiate radical innovative processes by themselves.

Further reading

- Raelin (1991) describes the activities of entrepreneurial professionals and the relation between these professionals and management.
- Hausschildt and Schew (2000) discuss the role and characteristics of gate keepers in innovative processes.
- Guildford (1959) and Amabile (2002) on creativity.
- O'Connor and McDermott (2004) on the human side of radical innovations.

C. Fast Learning

Goal	Creation of fast-learning processes that lead to the creation of basic ideas for radical innovation
Design guidelines	<ul style="list-style-type: none"> ▪ Start with knowledge acquisition from multidisciplinary and radical networks (see external knowledge network) ▪ Design scale and composition of 'virtual R&D-site' (small groups and participation by only 'white members') ▪ Create processes of experimentation ▪ Realize adequate levels of reflection and abstraction ▪ Stimulate personal knowledge building ▪ Create 'white' interventions ▪ Prevent yellow and blue properties and interventions ▪ Accept position of site on boundary of organization
Output	Fast-learning processes Basic ideas for innovation

Explanation and background

Essential for the creation of fast-learning processes that are maximally value enhancing is the concomitant occurrence of knowledge acquisition, experimentation, reflection and conceptualization (abstraction) and an attitude of personal knowledge building:

- Fast learning starts off with knowledge acquisition (and collective development) in the external knowledge network. New information and frame-breaking knowledge is provided and created and functions as a basic building block for the learning process. The wider the diversity of the knowledge network, the greater the knowledge potential and the potential for new combinations.
- Experimentation is essential for the creation of new insights and knowledge. It creates new and unlikely connections (Wenger, 1998) among different sets of information or re-contextualizes knowledge into new frames (in the case Pig City new knowledge was created by contextualizing insights from small scale rural projects in developmental countries to urban agriculture, leading to new ecological techniques for large scale pig farming).
- Reflection, conceptualization and abstraction lead to the discovery of patterns in new knowledge combinations and transform these into more abstract and unifying concepts with a maximum value for innovative activity (e.g. the CIA-concept in the case Pharmacy). 'Wild ideas and new combinations are thus transformed into 'unambiguous con-

cepts'. It is essential to move up and down the ladder of abstraction, until an unambiguous organizing structure and concept is discovered. Ambiguity in concepts leads to dispersed and unsuccessful radical innovations.

- A personal knowledge-building attitude is a basic condition for substantial experimental behaviour, reflection and the urge to create new concepts (rather than more meagre problem solution).

Fast-learning processes are strongly white in character and ask for a 'white R&D-site' and white interventions: room for experimentation, processes like dialogue, productive inquiry, structured reflective interaction and open socio-political processes (relations based on added value rather than existing coalitions). Fast learning is especially influenced negatively by yellow and blue properties and interventions, like conformity, group think, polarization, political process and power-based relations, and strong time pressure. Interventions have to be aimed at the removal of yellow and blue aspects.

Fast-learning processes need only a small number of participants. Mostly these are gate keepers and innovators, positive and pro-active members of the organization and/or members of the external knowledge network. Participation of others, besides gate keepers and innovators (and especially if these others are outsiders), may enrich the process of reflection and abstraction. The R&D-site can be positioned both within the KISF and at the boundary between the KISF and the external knowledge network.

Further readings

- Wenger (1995) on the communities of learning and imagination as a knowledge sourcing learning processes in these communities.
- The virtual network CommunityIntelligence (White Paper, 2003) describes processes that lead to radical innovations in communities of practice.
- O'Connor and McDermott (2004) describe the relation between multi membership and richness in the outcome of radical innovations.

D. Basic ideas

The idea generation phase leads to the creation of basic ideas for radical innovation. The value of these ideas for the subsequent innovation process can be assessed on the basis of:

Radicality	Basic ideas are frame braking
Diffusion	Low diffusion (innovation is not yet used by others in the network)
Utility	Abstraction: potential for generalization Codification: are basic ideas transferable
Strategic value	Fit with (future) strategic position and vision

Explanation

Basic ideas that lead to sustainable competitiveness are characterized by:

- The degree of radicality: Innovations are only valuable when the degree in which they are frame breaking is matched with trends in and speed of innovation in the (technological) environment. In order to realize sustainable competitiveness ideas will have to be more frame breaking or frame breaking in different directions than ideas of competitors.
- Low diffusion: Ideas for innovations will be more valuable, since they are more sparsely diffused in the external environment and are not yet used by competitors in the network or will be used by them in the near future.
- Adequate levels of abstraction and codification: They may lead to sufficient potential for generalization and transfer (this characteristic is, however, more important for the core concept than for basic ideas, as these still have to be processed for diffusion).
- Proper fit with strategic position and vision: It is mainly a task for top management to determine whether the basic ideas are valuable in terms of the strategic position that is aimed at and whether they are in line with the vision of the organization. This is determined by the contents of the ideas and the degree of radicality in relation to the desired direction of development of the organization (vision and strategy) and development in the external environment (Volberda and van den Bosch, 2004).

12.4.2 Crystallization

Phase	Crystallization
Main processes	Socio-political processes: Negotiation Information processing: Knowledge interpretation
Actors	Boundary spanners Gate keepers/innovators
Other characteristics	--
Management and Organizational conditions	Absorptive capacity
Output	Reified core concept

In the crystallization phase a core concept is formed and negotiated. This core concept sets the new frame of reference for the actual realization of the innovation. Our research showed that the crystallization phase is crucial for radical innovation. All unsuccessful cases missed a strong crystallization phase. The essence of the crystallization phase is formed by brokering (socio-political processes) and boundary objects (core concept):

A. Socio-political processes: interpretation and negotiation

Goal	Realize productive interpretation and negotiation processes that lead to the development of a reified core concept
Design guidelines	<ul style="list-style-type: none"> ▪ Cater for collective interpretation: <ul style="list-style-type: none"> ○ Absorptive capacity: Stimulate a degree (not total!) of repetition of information processing and fast learning ○ Reinterpret collective experience within the context of basic ideas ○ Check whether new concepts lead to performance and problem solving at a higher level of competence ○ Sharpen basic ideas to unambiguous and abstract core concepts ▪ Cater for collective negotiation: <ul style="list-style-type: none"> ○ Assess sustained value of core competences and need for remoulding and reinterpretation ○ Explain sustained value of core competences but stress need for remoulding and reinterpretation ○ Stimulate participation by boundary spanners with high influence and yellow capacities ○ Direction of the yellow negotiation process by top management of facilitators ○ Create ‘yellow’ interventions ○ Balance political processes from open (white influences) to more closed (yellow properties) ○ Verify that core concepts are reified (accepted) ▪ Assess and organize needed amount of boundary spanning points
Output	Productive interpretation and negotiation Reified core concept

Explanation and background

The crystallization phase is a transition point between processes of fast learning by a few individuals in the virtual R&D-network and slow learning by the collective of professionals in internal communities. In this transition phase there is a need for:

- *Collective interpretation* in order to integrate the new concepts and knowledge patterns into the organization.
- *Collective negotiation* in order to handle the political turbulence that is caused by uncertainties and disruption in the primary process.

Collective interpretation

Collective interpretation provides absorptive capacity in the KISF for knowledge developed in the external knowledge network. By collective interpretation the individual mental maps of gatekeepers are transformed into collective mental maps (Kim, 1993). Collective mental maps rely on sharing explicit knowledge (formal basic ideas) as well as sharing underlying assumptions and creation processes (Dixon, 1994). To share these, a partial rehearsal of the information

processing in the idea generation phase is needed. Partial rehearsal creates collective background information between gate keepers and core members of the organization that serves as a 'shared birth ground' for core concepts.

In addition to this, collective interpretation also serves as a platform for combining actual experiences with the primary process. Thus the core concept can be elaborated and also tested for suitability. Reconstruction of experiences within the context of the core concept has to provide for problem solutions at a higher level than previously ('can we perform at a better level than before when we apply the new core concept').

Collective interpretation has to be handled in such a way that it serves knowledge integration rather than mere knowledge transfer: it means not only taking over basic ideas, but internalizing these by collective reflection and conceptualization. This has to be performed till the concept reaches an adequate level of unambiguity and abstraction (clarity is essential for further proceeding in the innovative process).

Collective negotiation

Next to the cognitive process of collective interpretation, the development of an *accepted* core concept requires the political process of collective negotiation. Because the innovation entails a paradigm shift, strong uncertainties arise, triggering strong political turbulence. The uncertainties and turbulence are caused by a potential threat to the existing primary process (Boisot, 1998), by the threat to the position of the dominant coalition (Reed, 1996), and by the lack of participation in the innovative process often perceived by the collective of professionals (Wenger, 1998).

An upcoming paradigm shift often triggers a fear among the collective of professionals that reigning core competences will be devalued. This devaluation is a threat to the existing power and control base of the incumbent group of professionals, as their base and mechanisms for control of the primary process are eroded. It also makes them feel uncertain of the future, for they fear a lack in competence concerning an adequate performance in the innovated primary process. As explained in paragraph 12.3.2, the effect of radical innovation on core competences can move in two directions: the destruction of core competences, when these do not fit in the new frame of reference, or the enrichment and reconstruction of core competences, when it is made clear that these are an extension of the repertoire but need remoulding or reinterpretation in the context of the new frame of reference. As we stated this means an end to the KISF, since it includes total capital destruction of competences and thus knowledge workers. Usually this is not a feasible option. Radical innovation in KISFs asks for remoulding and reinterpretation of core competences (although a certain amount of capital destruction will be inevitable)². In this light collective negotiation serves the function of convincing professionals that remoulding and reinterpretation is both necessary and beneficial. Collective negotiation has to focus on opening up old boundaries and norms and setting new boundaries and norms that fit in the new frame-of-reference. In effect, the conditions for the creation and acceptance of a 'green site for slow learning' in the evolution phase need to be set.

² In our cases the architectural firm of MVRDV was very strong in actually creating new paradigms on the basis of the combination of newly created and existing core competences in the firm. They were able to transform this ability into an innovating core competence in itself.

Convincing techniques in collective negotiation are based both on politics of reification as materialized in the core concept and on politics of participation based on influence, personal authority, trust, friendship and ambition (Wenger, 1998). The mere creation of a core concept is not enough. The concept needs to be accepted by a number of key actors (boundary spanners) in order to serve as an instrument for alignment of the innovative process.

Due to collective negotiation, the crystallization phase is a strong yellow change process that demands yellow interventions. But the collective interpretation is more white in character (requesting collective search and dialogue). In practice the crystallization phase moves from an open to a closed political character. At the start there is a need for white properties and interventions (open processes), but during the process the demand for yellow properties and interventions increases. The managing of white and yellow interventions demands strong balancing skills from involved process managers.

Depending on the complexity of the innovation and the 'landing environment', multiple points for boundary spanning need to be created. This may improve strength of integration in the environment but may also lead to conflicts between these boundary spanning points.

Further readings

- Hansen (1991) treats the relation between knowledge search and knowledge transfer to the organization.
- Cohen and Levinthal (1990) and Rosenkopf and Nerkar (1999) give an extensive treatment of boundary spanning activities and the role of absorptive capacity in innovation processes.
- Wenger (1998) gives an elaborate treatment of the politics of reification and participation and the function of alignment in the functioning of communities of practice.
- Reed (1996) treats the aspects of power and control in relation to shifts in dominant technology and knowledge bases in professional organizations.

B. Boundary Spanners

Goal	Identification of boundary spanners and creating room for development of core concepts
Design guidelines	<ul style="list-style-type: none">▪ Identify boundary spanners on the basis of their characteristics (see explanation)▪ Check the abilities of boundary spanners or stimulate development of necessary abilities (see explanation)▪ Link gate keepers/ innovators and boundary spanners▪ Create a 'safe and rich environment' for interpretation and negotiation▪ Provide boundary spanners and gate keepers/innovators with formal support for their activities (top management support)
Output	Capable boundary spanners Adequate negotiation and interpretation

Explanation and background

Key persons in the socio-political process in the crystallization phase are gate keepers/innovators and boundary spanners. Gate keepers/innovators serve as the source of the basic ideas. Boundary spanners serve as the key actors in integration and negotiation of these ideas and are as such essential for the creation of accepted core concepts. They are '*ambassadors whose activities consist of political activities such as lobbying for support in the collective of professionals as well as buffering the team from outside resistance to the new paradigm*' (Brown and Eisenhardt, 1995, pp. 356).

Gate keepers and innovators are often peripheral members of the organization. As a consequence their ideas for innovation are often not accepted by the collective of professionals. This decreases the acceptance of radical innovations by the organization. Radical innovation thus requires protection of gate keepers and their ideas by boundary spanners. Only through this protection and the process of collective interpretation and negotiation can radical innovations be imported into the organization.

In line with their role in the interpretation and the negotiation process, boundary spanners rely on characteristics and abilities that are beneficial for both processes:

- *Information processing characteristics and skills:* T-shaped knowledge³ that allows for absorptive capacity for paradigm changes; an inclination towards development of new paradigms; ability for knowledge interpretation and experimentation; a stronger tendency towards (strategic) problem solving than towards mere personal knowledge building; the ability to integrate new paradigms with existing core competences and the strategic development of the KISF (strategic recognition capacity).
- *Political characteristics and skills:* a core position in the organization, where position professional status provides for the autonomy to make independent and deviant decisions; capacity to function as a role model; position that legitimates knowledge distribution and application in the organization; create trustful relationships between gatekeepers and professional coalitions; ability to overcome obstacles to innovation (including resistance to change) in the organization.

In general in KISFs boundary spanners are senior professionals with a strong position in the professional collective. In cases where the realization of radical innovations also depends on acceptance in the external environment, boundary spanning should be performed by external decision makers who can influence the process of acceptance. They might be senior policy makers but also key clients who may use the innovation. Clients certainly have a stronger role in fine tuning the core concept for innovation and in the acceptance process than in originating the innovation.

Boundary spanning is positively influenced by collective brokering, in which more boundary spanners function in a collective. Our experience has shown that a mixture and proper balancing of proponents and (mild) opponents in the boundary spanning group facilitated crystallization.

³ T-shaped where the stem of the T stands for a deep knowledge of one discipline and the layer of the T stands for a broad knowledge of more disciplines.

Further readings

- Brown and Eisenhardt (1995) and Leonard-Barton (1995) give an description of role and characteristics of boundary spanners.
- Wenger (1998) elaborates on the position of membership and brokering.

C. Core concept

The end product of the crystallization phase is a core concept that forms the frame of reference for the actual realization of the innovative process. Adequacy of the core concept for the proceedings of the rest of the innovation process can be assessed on the basis of:

Radicality	Core concept is frame braking
Reification	Core concept is 'materialized'
Codification	Unambiguous
Degree of abstraction	Potential for generalization Room for evolution Frame for remoulding experience
Evaluative function	Core concept is used as a testing stone
Strategic value	Fit with (future) strategic position and vision

Explanation and backgrounds

Core concepts (or 'boundary objects' or 'prototypes') serve an essential function in radical innovations. They serve as an interface between multiple communities (virtual R&D-network, gate keepers and boundary spanners, and internal professional community) and multiple paradigms (a translation and interpretation platform between the new paradigm and existing experiences and competences). Core concepts function as 'tangible' (meaning 'clear') objects that provide new and collective meaning and language for the innovation process. It is the 'materialization' of the new dominant design. Absence of core concepts leads to dispersed innovations without synergy and with a lack of radicality.

Due to pressure and counter pressure in innovation and due to the autonomous character of the primary process in KISFs, effective core concepts need to balance between:

- Reified character⁴ and the flexibility to adopt personal interpretation and creative implementation.
- Anchoring, and a scope for application and evolution.
- Frames primary process in new paradigm and provides room for autonomy in the professional process.
- A common identity (unambiguous) and adaptation for local needs service delivery.

In order to provide for this balance, core concepts need to be defined at an adequate level of reification, abstraction and codification.

⁴ reification: to treat an abstraction as substantially existing or as a concrete material object

In the subsequent process of innovation, the core concept has to serve as a test for paradigm change in the primary process.

Further readings

- Dougherty (2000) describes the role of prototypes in the creation of radical innovations in the service industry.
- Star and Griesemer (1989) and Fujimura (1992) discuss the function of boundary objects and standardized packages as translation objects between different communities.
- Nonaka et al. (2000) describe boundary objects as one of the elements in *ba* as a shared context for knowledge creation and utilization.

12.4.3 Evolution

Phase	Evolution
Main processes	Information processing; Knowledge distribution and –application Learning: Slow Learning
Actors	Executing professionals Boundary spanners
Management and Organizational conditions	Continuous improvement capacity Learning culture and structure
Output	Innovative artefacts and processes; improvements; reinventions

In the evolution phase the actual innovation is realized through the development of innovative artefacts, services and processes. The evolution of innovative practices within the new paradigm takes place. Incremental innovation is thus a main characteristic of this phase. Incremental innovation requires slow learning.

Slow learning

Goal	Facilitation of slow learning processes that lead to the creation of actual innovative artefacts and enduring incremental innovation
Design guidelines	<ul style="list-style-type: none"> ▪ Start with distribution of core concept ▪ Check experience interpretation and knowledge application within the new framework ▪ Design green learning sites for incremental innovation (culture and structure for continuous innovation) ▪ Stimulate innovative problem solving ▪ Create green interventions ▪ Position learning site in organization but stimulate and accept boundary spanning activities
Output	Innovative artefacts Enduring incremental innovation

Explanation and background

Without slow learning the maximum value created in the idea generation phase is not capitalized. Therefore slow learning is important to cash in on the gains from the idea generation and crystallization phase.

Slow learning has two main functions in which one more or less follows the other:

- Interpret experiences within the new frame of reference (core concept) and develop and apply innovative services on the basis of this interpretation (adaptation to local needs and the work process). Boundary spanners play an important translation and frame-setting role in this. This process may have yellow characteristics due to resistance in the professional community to the new practices and paradigms. Green characteristics are related to the process of assisting professionals in applying new concepts.
- After acquiring experiences with innovative approaches, a setting for continuous innovation is created. This 'green learning site' provides a place and culture for the exchange of experiences, for sharing new perspectives, and for subsequent incremental innovation. Client involvement and boundary spanning may provide rich learning sources for this.

For both functions the original core concept serves as a measure for keeping the old paradigm from creeping back in.

Further readings

- Terziowski (2003) and Utterback (1994) on the importance of intermittent radical and incremental innovation.
- Literature on social construction as an essential learning style in this phase.

12.4.4 Management and organizational conditions

In line with recent publications and the findings from this study we want to quote that: '*In today's business environment, there is no task more vital and demanding than the sustained management of innovation and change*' (Tushman and Nadler, 1986, pp. 74). In order for KISFs (and organizations with knowledge workers) to remain competitive in the longer run, radical innovation is not a one-off process but should become a continuing cycle for strategic renewal. Consequently, management has a task at both the level of the separate innovation processes (tasks per phase) and at the level of the creation of continuing innovation processes.

In managing a continuing innovation process, there is a major role for top management. This role focuses on:

- *Recognizing innovative capabilities as core capabilities for the future, prioritizing these capabilities and facilitating the development of these capabilities:* Essential capabilities that lie outside the direct scope of management are capabilities for the creation of virtual R&D-networks and for effective participation in these networks (fast learning competences) and capabilities for slow learning. In line with Kessels' (1996) arguments in favour of the corporate curriculum as a tool for development of capabilities, we agree there is a need for a *corporate innovation curriculum*, with a focus on the development of capabilities that are essential for sustained radical innovation. One tool for stimulating the

development of innovative capabilities may be the measurement of performance on this item. Performance measurement should focus not only on direct performance in the primary process and return-on-investment but also on innovative activities and results in terms of new radical ideas.

- *Management of the balance between processes of exploration (idea generation) and exploitation (evolution):* As we argued in paragraph 12.3.2 excessive exploitation will in the longer run lead to capital destruction and loss of strategic position. There is a danger that formerly valuable services and competences may turn into *competence traps* (Levinthal and March, 1993). On the other hand, too strong an emphasis on radical innovation, and thus on exploration, may lead to the danger that there is too little emphasis on capital creation and exploitation and to the danger that the centrifugal effects of radical innovative ideas destroy the identity of the organization. The organization might get caught in a *renewal trap* (Volberda and van den Bosch, 2004). It is essential for top management to find a proper balance in the portfolio between explorative and exploitative activities and to tune in this balance with the developments and innovation rate in the external environment.
- *Managing radical innovation as a competence-enriching rather than competence destructing process:* As stated in paragraph 12.2.2, it is essential for KISFs that both the contents of basic ideas and the way in which the innovation process is managed leads to a richer and more valuable use of existing competences rather than to the destruction of competences. This demands both a major influence from top management on the selection of basic ideas and a strong guidance of the strategically adequate reframing and remoulding of existing competences during the evolution phase (a point of attention here must be maintaining the actual realization of the innovation at a radical level rather than allowing it to fall back into the 'old groove').
- *The management of the overall process of innovation:* This concerns not only managing the separate phases but emphasizes the necessary management of transformation from one phase to the other. A major point of attention in this matter is the management of differences in speed between the idea generation phase and the evolution phase. Paradoxically fast learning needs stability and a certain degree of serenity in order to provide enough room for reflection and experimentation. Slow learning on the other hand requires speed to turn ideas into actions faster than competitors. It is a central task of management to change gear between these two different speeds and to generate or stimulate the different learning styles and activities that go with these speeds.

Apart from general tasks for management in the innovation process, there are also a number of specific tasks in each phase. These tasks are divided between those that concern top management and those that concern middle management (included in this discussion are the tasks of facilitators of the innovation process, although this may be a separate role, we consider this role for this discussion as a part of the task of management). Apart from management tasks, radical innovation also requires special organizational conditions. We treat these together with management tasks.

Idea generation phase

The central role in the idea generation phase for top management is:

- *Strategic recognition of the onset of new phases of exploration:* Matching external developments with the internal speed of renewal within the organization and stimulating or facilitating development of new paradigms that are in line with the external developments. The onset of new phases of exploration may rely either on top management (searching gatekeepers and innovators and helping in creation of virtual R&D-sites) or, as may often be the case in KISFs, on gatekeepers and innovators. In the last instance the role of top management focuses on strategic recognition and a subsequent matching of the rate of onset of new cycles of innovation in line with the strategic position of the organization.
- *Strategic recognition by stimulating/accepting the direction of radical innovation:* This role is mostly related to the recognition and selection of valuable 'white sides' that emerge within the organization (selection of valuable gatekeepers and innovators, valuable and rich R&D-sites, and valuable ideas for innovation) but may also be related to the active development of these white sites by top management. The value of white sites will either be determined by a vision already formulated by top management or will be determined by the capacity of top management to recognize valuable strategic autonomous behaviour by professionals (where necessary with help from middle management as they observe more closely the appearance of new strategic behaviour). In both cases it is the task of top management to match the emergence of radical innovations with trends in the external environment and trends within the rest of the organization. In those organizations with already existing diverse external R&D-networks, the role of top management concentrates on the management of the portfolio of networks within the context of strategic trends
- *Facilitation of fast learning capabilities:* It is the task of both top and middle management to stimulate the development of capabilities in promising professionals which are necessary for (a) the creation of and participation in virtual R&D-networks, (b) the realization of fast learning and (c) the ability to formulate valuable basic ideas
- *Management of strategic fixedness:* Managing the trade-off between capital destruction and value creation by abandoning dominant paradigms and trading them for new uncertain paradigms. This is a role that relies on top management.
- *Organizational conditions:* Creation of 'white virtual R&D-sites' based on strategically valuable networks and the facilitation and acceptance of processes of fast learning. In general we find that 'white virtual R&D-sites' benefit from isolation from the ongoing primary process in the firms, since this primary process may put too much short term performance pressure on the site. Isolation may require the creation of temporary structures for these virtual R&D-sites

Crystallization phase

There are some tasks for middle management in this phase, but the emphasis is on tasks for top management.

- *Setting the stage for interpretation and negotiation:* Important in setting the stage for collective interpretation and negotiation is casting effective boundary spanners (on the basis of the criteria mentioned in paragraph 12.4.2). This role lies with top management in combination with middle management in terms of their collective ability to recognize

valuable boundary spanners and with top management alone in terms of convincing boundary spanners of the need for radical innovation.

- *Supporting gatekeepers and innovators and their ideas:* In order to overcome strategic fixedness, realize the abandonment of dominant paradigms and trade these for new, uncertain paradigms, a considerable degree of support from top management for gatekeepers/innovators and their ideas is necessary.
- *Organising absorptive capacity:* Although collective interpretation and negotiation for the creation of core concepts will take place mainly between gatekeepers/innovators and boundary spanners themselves, top management has an essential role in the direction of this process. This role regards setting the stage for interpretation and negotiation (organizing sessions), creating yellow interventions, managing strategic fixedness, opening new perspectives for the professional community, and catering to competence-enriching rather than competence-destroying innovations.
- *Strategic recognition of valuable core concepts:* Both in terms of contents and in terms of the form of the core concept (radicality, abstraction, etc.) management has a role in steering, recognizing and selecting those core concepts that have an essential role in radical innovation.
- *Organizational conditions:* The emphasis in the crystallization phase is on process-management more than on organizational conditions in terms of culture or structure. As such, organizational conditions are related to the selection of important actors, setting the stage for interpretation and negotiation, and imposing of yellow process intervention by management.

Evolution phase

In the evolution phase the emphasis in the role of management shifts from top to middle management.

- *Stimulating the process of reframing of experiences and competences:* It is a task for middle management to see to the actual reprocessing of existing competences and experiences in the light of the new frame of reference. The role of management lies in coaching this process of reframing (offering training and coaching where necessary), stimulating and checking the level of innovative output that results from reframing and redesigning, redesigning the primary process, and preventing regression to old levels of performance.
- *Stage setting for slow learning:* Although knowledge workers will play a role in the creation of green learning sites within the professional community, the creation of these sites also presents an important role for middle management. Middle management has to see to and accept the emergence of green sites but also has to create actively these green sites themselves (e.g. by creating learning groups, sites for exchange of experiences and the creation of further developments).
- *Organizational conditions:* Organizational conditions concern the redesign of the primary process to incorporate changes in the primary process and the creation of a culture and structure for sustained slow learning (see the preceding bullet).

12.5 SUGGESTIONS FOR FURTHER RESEARCH

This study raises a number of issues for further research, for we came across some phenomena that require more investigation.

Although we analyzed the economic value of different phases of the innovation process and elaborated on the cycle of value and capital creation and value and capital destruction, these items were not part of our empirical research. In this context our statements are tentative and have not been empirically tested. We have also not determined or discussed what possible criteria might be available for deciding on the trade-off between capital destruction and value creation in relation to innovation. Still, we think that competent decision making in this issue is an important aspect of the contribution of radical innovation to sustainable strategic competitiveness. Insights into factors that determine the need for renewed value creation and thus capital destruction, and insight into accounting of value creation and capital destruction may help management in balancing the cycles between exploitation and exploration (Volberda and van de Bosch, 2004). This can focus the proper assignment of resources to the different phases in innovation. In line with this we would like to plead for the development of a new line of accountancy: '*innovation-accountancy*'. Innovation-accountancy has to provide financial insights on the items of value- and capital-creation and destruction, on the trade-off between these aspects. It should also provide decision-support-information for the start of fresh radical innovation processes. In order to develop this decision-support-information, a quantification of the processes of value- and capital- creation and destruction are needed. For this, research into the economy of value creation is necessary.

In parallel with the work on influences on the knowledge creation processes (development of social capital) in knowledge networks by Nahapiet and Ghosal (1998), there is also a need to create more understanding about the elements that determine the strategic value and richness of the output of knowledge networks. Besides to *process-characteristics* there are certainly also *content-characteristics* that determine the output of the knowledge network. Until now most work on knowledge networks concerned the communication processes and more cultural aspects of the network and the effect of these factors on the effectiveness and output of the network (e.g. Brown and Eisenhardt, 1995; Nahapiet and Ghosal, 1998). A question, however, that seems equally relevant in this context is how the composition and type of knowledge in the virtual R&D-network may affect the output of this network. Hypotheses that can be formulated in this context are: the output of a virtual R&D-network is positively correlated with the number of different disciplines that are represented in the network; participation of both clients and suppliers in the knowledge network will yield more strategically valuable output; participation of different, not yet related, professional groups in knowledge networks will yield more radical output, etc. Uncovering more of the hidden knowledge on virtual R&D-networks may help gatekeepers and top management decide what sort of R&D-networks in which to participate and how to create valuable and rich R&D-networks themselves.

In our second chapter we touched on the subject of the design of organizational conditions and the role of management in creating learning environments (the concept of the corporate curricula as developed by Kessels, 1996). Although we had intended to incorporate this subject into our empirical research, it has been submerged by other subjects of our study. In our view the design for a '*corporate innovation curriculum*' is well worth studying. This is especially relevant in the

context of the development of 'white virtual R&D-sites' and the creation of fast-learning processes. Most of the existing research and studies concern the conditions for slow learning and the creation of green learning environments. This is definitely an important aspect of the innovation process, but we think that more substantial attention is needed for the design of 'white virtual R&D-sites'. On the basis of the findings in this study about the 'white processes' that take place in the idea generation phase, further research could be performed on the design for these phases. This research might question propositions such as: where to position gate keepers in the external network and in the KISF; the adequate frequency and type of contacts between gatekeepers and others in the network; the design and setting for fruitful experimentation and reflection and conceptualization; and the design for the trade-off between personal knowledge building and the creation of strategically valuable ideas for the organization (e.g., the amount of tranquillity versus time pressure and stress on performance, and the motivational and affective abilities needed to function as a gatekeeper).

This study was not designed to uncover and test empirically the personalities and characteristics of gate keepers, innovators and boundary spanners. We feel there is already ample attention in research and literature on characteristics and abilities of gate keepers and innovators (e.g. Walter, 1989; MacDonald et al, 1993; Shane, 1994; Caird, 1994; Hauschildt and Schewe, 2000). We have not yet, however, come across extensive work on the characteristics and abilities of boundary spanners in the politically charged environment of KISFs. In line with the notion that, due to the highly political character of (innovation in) KISFs, there is a strong determining role for boundary spanners for the success of radical innovation, we think that this item needs special interest and is well worth studying. Although we can draw some conclusions on the importance of the political status of boundary spanners and on their ability to influence others, we still feel that we lack an adequate picture of the characteristics and abilities of boundary spanners. Further research into the characteristics and abilities of boundary spanners may have a major role in facilitating radical innovation in KISFs.

Consequently, although we certainly researched the socio-political aspects of radical innovation in KISFs, we believe that this part of the research has not yet received the emphasis and thoroughness it deserves. It would certainly provide valuable knowledge on radical innovations in KISFs if the research on the political aspects of the innovation process was more strongly linked to the scarce literature on political processes in KISFs (e.g Pfeffer, 1992; Reed, 1996). Questions that will have to be addressed may be related to 'what type of power bases for boundary spanners have a more or less stronger influence on acceptance of core concepts', 'whether acceptance of radical innovations is positively influenced by clarifying competence enriching rather than by competence destroying scenarios', 'what are the effects of participation of boundary spanners in virtual R&D-sites' and 'what are the differences in terms of socio-political processes between organizations with a settled and adequate cycle of radical and incremental innovation and organizations in which radical innovation is a one-off event'. Insights in these matters may help the development of innovative capabilities in KISFs.

REFERENCES

- Abernathy, W.Y. and Uterback, J.M. (1978). Patterns of industrial innovation. *Technology Review*
- Aken, J.E. van (1994). Het ontwikkelen van wetenschappelijke kennis voor organisaties vanuit spelersperspectief [Developing scientific knowledge for organizations from an actors' perspective]. *M&O* vol 48, (4), pp. 388-404.
- Amabile, T. (1998). How to kill creativity. *Harvard Business Review*, September-October, pp. 77-87
- Amabile, T.M., Hadley, C.N., Kramer, S.J. (2002). Creativity under the gun. *Harvard Business Review*
- Araujo, L. (1998). Knowing and learning as networking. *Management Learning*. vol. 29 (3), pp. 317-336
- Argyris, C. & Schön, D. (1996). *Organizational learning 2. Theory, method and practice*. Reading, Massachussets: Addison-Wesley
- Argyris, C. and Schön, D. (1974). *Theory in practice, increasing professional effectiveness*. San Francisco: Jossey-Bass
- Argyris, C. and Schön, D. (1978). *Organizational learning*. Reading, Mass.: Addison-Wesley
- Bateson, G. (1972). *Steps to an ecology of mind*. San Francisco: Chandler Publishing Co.
- Berends H. (2003). *Knowledge sharing in industrial research*. Eindhoven: Eindhoven University Press
- Bilderbeek, R., Hartog, P. den, Marklund, G., and Miles, I. (1998). *Services in innovation: Knowledge Intensive Business Services (KIBS) as co-producers of innovation*. S14S, S3, Step Group
- Blackler, F. (1995). Knowledge, knowledge work and organizations: an overview and interpretation, *Organization Studies*, vol. 16, pp. 1021-1046
- Boisot, M. (1998). *Knowledge assets: Securing competitive advantage in the information economy*. Oxford: University Press
- Brown, J.S. and Duguid, P. (1991). Organizational learning and communities of practice: toward a unified view of working, learning and innovation. *Organization Science*, vol 2 (1)
- Brown, S.L. and Eisenhardt, K.M. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review*, vol. 20 (2), pp. 343-78
- Burgelman, R.A. (1983). Corporate entrepreneurship and strategic management: Insights from a process study. *Management Science*, vol. 29, pp. 1349-64
- Burgelman, R.A., and Rosenbloom, R.S. (1989). Technology strategy: an evolutionary process perspective. *Research on Technological Innovation, Management and Policy*, pp. 1-23
- Burgelman, R.A., Maidique, M.A., Wheelwright, S.C. (1996). *Strategic management of technology and innovation*. Chicago: Irwin
- Caluwé, L. de en Vermaak, H. (1999). *Leren veranderen: Een handboek voor de veranderkundige* [Learning to change: a handbook for the change agent]. Alphen aan de Rijn: Samsom

- Clark, K.B., (1987). Managing technology in international competition: The case of product development in response to foreign entry. In Spence, M. and Hazard, H. (eds) *International Competitiveness*. Cambridge, MA: Ballinger Publishing
- Cohen, W.M. and Levinthal, D.A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, vol. 35, pp. 128-152
- CommunityIntelligence, (2003). Radical Innovation with communities of practice. *White paper*
- Cook, S. and Brown, J.S. (1999). Bridging epistemologies: the generative dance between organizational knowledge and organization knowing. *Organization Science*, vol 10 (1), pp. 381-400
- Coombs, R. (1999). *Innovation in services: Overcoming the Services-Manufacturing Divide*. Antwerpen: Maklu-Uitgevers n.v.
- Cozijnsen, A.J. en Vrakking, W.J. (1992). *Ondernemen en vernieuwen* [Entrepreneurship and innovation]. Deventer: Kluwer Bedrijfswetenschappen
- Daft, R.L. and Weick, K. (1984). Toward a model of organizations as interpretation systems. *Academy of Management Review*, vol. 9 (2), pp. 284-295
- Davenport, T.H. en Prusak, L. (1998). *Working knowledge*. Oxford: Harvard Business School Press
- Delden, P.J. van (1992). *Professionals: kwaliteit van het beroep* [Professionals: Quality of the profession]. Amsterdam: Contact
- Dewey, J. (1938). *Logic: The theory of inquiry*. New York: Holt, Rinehart and Winston
- Dixon, N. (1994). *The organizational learning cycle. How we can learn collectively*. London: McGraw-Hill
- Dodgson, M. (1993). Organizational learning: A review of some literatures. *Organizations Studies*, vol 14 (3), pp. 375-394
- Dougherty, D. (1990). Understanding new markets for new products. *Strategic Management Journal*, vol. 11, pp. 59-78
- Dougherty, D. (2000). *Structuring practice-based knowledge in service organizations*. Antwerpen: Maklu-Uitgevers n.v.
- Drazin, R. (1990). Professionals and innovation: structural-functional versus radical-structural perspectives. *Journal of Management Studies*, vol. 27 (3), pp. 245-64
- Drucker, P. (1988). The coming of the new organization. *Harvard Business Review*, vol. 5, pp. 53-65
- Drucker, P. (1993). *Post-capitalist society*. Oxford: Butterworth-Heinemann
- Easterby-Smith, (1997). Disciplines of organizational learning, contributions and critiques. *Human Relations*, vol.30 (9), pp.1085-1113
- Easterby-Smith, M., Burgoyne, J., Araujo, L. (eds.). (1999). *Organizational learning and the learning organization*. London: Sage Publications
- Eisenhardt, K.M., Santos, F.M. (2002). Knowledge-based view: a new theory of strategy? In: Pettigrew, A., Thomas, H., Whittington, R., (eds). *Handbook of strategy and management*. London: Sage Publications, pp. 139-164

- Elkjaer, B. (1999). In search of a social learning theory. In: Easterby-Smith, M, Burgoyne, J. and Araujo, L. *Organizational learning and the learning organization*. London: Sage Publications
- Eygenraam, D. (1995). *Professionals een onbestuurbaar volkje!?* [Professionals an unmanageable people?!]. Afstudeerscriptie. Nijmegen: Katholieke Universiteit
- Finger, M. and Bürgin Brand, S. (1999). The concept of the 'learning organization' applied to the transformation of the public sector: Conceptual contributions for theory development. In: Easterby-Smith, M, Burgoyne, J. and Araujo, L. *Organizational learning and the learning organization*. London: Sage Publications
- Fujimura, J.H. (1992). Crafting science: standardized packages, boundary objects and "translation". In: Pickering, A., *Science as practice and culture*. Chicago: The university of Chicago Press, pp. 196-211
- Gieskes, J. (2001). *Learning in product innovation processes: Managerial action on improving learning behaviour*. Twente: Ph.D. Thesis, Enschede, Universiteit Twente
- Glaser, B.G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press
- Guildford, G.P. (1959). Three faces of intellect. *The American Psychologist*, vol.14, pp. 469-479
- Hansen, M.T. (1999). The search-transfer problem: the role of weak ties in sharing knowledge across organizational subunits. *Administrative Science Quarterly*, vol. 44, pp. 82-111
- Hansen, M.T., Nohria, N., Tierney, Th. (1999). What's your strategy for managing knowledge. *Harvard Business Review*, vol. 4, pp. 106-116
- Hart, H.W.C. and Vries, R. (1986). Marketing-strategische aspecten bij de lancering van nieuwe producten [Marketing-strategy aspects in new product launching]. In: Cozijnsen, A.J. and Vrakking, W.J. *Ondernemen en vernieuwen*. Kluwer Bedrijfswetenschappen
- Hauschildt, J. and Schewe, G. (2000). Gatekeeper and process promoter: key persons in agile and innovative organizations. *International Journal of Agile Management Systems*, vol. 2 (2), pp. 96-104.
- Henderson, R.M. and Clark, K.B. (1990). Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, pp. 9-30
- Hertog, P. den (2000). Knowledge-intensive business services as co-producers of innovation. *International Journal of Innovation Management*, vol. 4, pp. 491-528
- Hertog, P. den, Broersma, L., Ark, van B. (2003). Notes and communications on the soft side of innovation and its policy implications. *The Economist*, vol. 151 (94), pp. 1-20
- Hippel, von, E. (1988). *The sources of innovation*. New York: Oxford University Press
- Huber (1991). Organizational learning: the contributing processes and the literatures. *Organization science*, vol. 2 (1), pp. 88-125
- Huber, G.P. Organizational learning: a guide for executives in technology-critical organizations. *International Journal of Technology Management*, vol. 11 (7/8), pp. 821-832
- Kessels, J. (1994). Dialectiek als instrument in de vorming van een lerende organisatie [Dialectics as an instrument in the creation of a learning organization]. *M&O*, vol. 5, pp. 452-477

- Kessels, J.W.M. (1996). *Het corporate curriculum* [The corporate curriculum]. Leiden: Inaugurale rede, Rijks Universiteit Leiden
- Kessels, J.W.M., and Poell, R.F. (2001). *Human Resource Development: Organiseren van het leren* [Human Resource Development: Organising learning]. Samson
- Kim, D.H. (1993). The link between individual and organisational learning. *Sloan management review*, pp. 37-50
- Kogut, B. (2000). The network as knowledge: generative rules and the emergence of structure. *Strategic Management Journal*, vol. 2 (4), pp. 327-44
- Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall
- Krogh, G. von, Ichijo, K. and Nonaka, I. (2000). *Enabling knowledge creation: How to unlock the mystery of tacit knowledge and release the power of innovation*. Oxford: Oxford University Press
- Krogt, F., van der (1991). Autonomie en leren van professionals [Autonomy and learning by professionals]. *Opleiding & Ontwikkeling*, vol. 9, pp. 15-18
- Kwakman, C.H.E. (2001). Leren van professionals tijdens de beroepsuitoefening [Learning-on-the-job by professionals]. In: Kessels, J.W.M., and Poell, R.F. (eds). *Human Resource Development: Organiseren van het leren*. Samson
- Kwakman, C.H.E. and Poell, R.F. (1999). Organiseren van lastige leerprocessen [Organizing difficult learning processes]. *Opleiding & Ontwikkeling*, vol. 7/8, pp. 17-21
- Lam, A. (2000). 'Tacit knowledge, organizational learning and societal institutions: An integrated framework'. *Organization Studies*, vol. 21 (3), pp. 487-513.
- Latour, B. (1987). *Science in action*. Milton Keynes: Open University Press
- Lave, J. The practice of learning. In S. Chaiklin and J. Lave, (eds). *Understanding practice. Perspectives on activity and context*. Cambridge: Cambridge university Press.
- Leeuw, A.C.J. de (1996). *Bedrijfskundige methodologie: Management van onderzoek* [Management-science methodology: Research management]. Assen: Van Gorcum
- Leonard-Barton, D. (1995). *Well springs of knowledge, building and sustaining the sources of innovation*. Boston: Harvard Business School Press
- Lindberg, M.A. (1998). The process of change: Stories of the journey. *Academic Medicine*, vol 7 (9), pp. 4-10
- Lowyck, J. (2001). Ontwerpen van leertrajecten [Developing learning trajects]. In: Kessels, J.W.M., and Poell, R.F. (eds). *Human Resource Development: Organiseren van het leren*. Samson
- Maidique, M.A. and Hayes, D.H. (1984). The art of high technology management. *Sloan Management Review*, pp. 18-31
- Maister, D.H. (1997). *True professionalism*. New York: The Free Press
- Maister, D.J. (1985). *Managing the professional service firm*. New York, the Free Press
- March, J.G. (1991). Exploration and exploitation in organizational learning. *Organizational Science*, vol 2 (1), pp. 71-85
- Mastenbroek, W.F.G. (1992). *Macht en communicatie* [Power and communication]. Alphen aan de Rijn: Samson Bedrijfsinformatie

- Miles, M.B. and Huberman, A.M. (1984). *Qualitative data analysis*. London: Sage
- Mintzberg, H. (1979). *Structures in fives, designing effective organizations*. Englewood Cliffs, NJ: Prentice-Hall
- Moore, K. and Birkinshaw, J. (1998). Managing knowledge in global service firms: Centers of excellence. *Academy of Management Review*, vol. 12 (4), pp. 81-92
- Morgan, G. (1986). *Images of organizations*. London: Sage
- Muller, E. (1999). *Innovation interactions between knowledge-intensive business services and small and medium-sized enterprises: analysis in terms of evolution*. PhD dissertation. Strassbourg : Faculté des Sciences Economiques et de Gestion, Université Louis Pasteur
- Muller, J. (2004). *Radical innovations in KISFs: test of application of a process design model*. Dissertation for masters' degree. Rotterdam: Erasmus University
- Nadler, D.A. and Tushman, M.L. (1990). 'Beyond the charismatic leader: Leadership and organizational change'. *California Management Review*, Winter, pp. 77-97
- Nahapiet, J. and Ghoshal, S. (1998). 'Social capital, intellectual capital, and the organizational advantage'. *Academy of Management Review*, vol. 23 (2), pp. 242-266
- Newell, S., Robertson, M., Scarbrough, H. and Swan, J. (2002). *Managing knowledge work*. Hampshire: Palgrave
- Ngy, E. and Bereiter, C. (1992). Three levels of goal-orientation in learning. *The journal of learning sciences*, vol. 1, pp. 243-273
- Nonaka, I. and Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York/Oxford: Oxford University Press
- Nonaka, I., Toyama, R. and Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Planning*, vol. 33, pp. 5-34
- O'Connor, G.C. and McDermott, C. (2004). The human side of radical innovation. *Journal of Engineering and Technology Management*, vol. 21, pp. 11-30
- Onstenk, J. (1997). *Lerend leren werken. Brede vakbekwaamheid en de integratie van leren, werken en innoveren* [Learning to work by learning: broad professional competence and the integration of learning, working and innovating]. Ph.D dissertation. Delft: Eburon
- Otto, M., and van Poucke, A.B.M. (1992). Bestuur, directie en medische staf: samenwerking in balans [Board of governors, CEO's and medical specialistes: collaboration in balance]. *Ziekenhuis Management Magazine*, vol 7 (8), pp.
- Pentland, B. and Reuter, H. (1994). Organizational routine as grammar of action. *Administrative Science Quarterly*, vol. 39, pp. 485-500
- Pfeffer, J. (1981). *Power in organizations*. Marshfield, MA: Pitman Publishing
- Pinchot III, G. (1985). *Intrapreneuring: Why you don't have to leave the corporation to become an entrepreneur*'. New York: Harper and Row
- Polanyi, M. (1966). *The tacit dimension*. London: Routledge & Kegan Paul
- Poucke, A.B.M. van en Wijk, H.E. van (1995). *Besturing van professionele organisaties: van praktijk naar onderneming* [Governance in professional organizations: from shop to enterprise]. Assen: Van Gorcum

- Prahalad, C.K. and Hamel, G. (1990). The core competence of the organization. *Harvard Business Review*, pp: 79-91
- Raelin, J.A. (1991). *The clash of cultures: Managers managing professionals*. Boston, Mass: Harvard Business School Press
- Reed, M.I. (1996). Expert power and control in late modernity. *Organization Studies*, vol. 17 (4), pp. 573-97
- Robinson, A.G. and Stern, S. (1997). *Corporate creativity*. San Francisco: Berrett-Koehler Publishers
- Romiszwoski, A.J. (1990), Trends in corporate learning and development. In: Mulder, M., Romisowski, A.J., and Sijde, van der P.C. (eds). *Strategic human resource development*. Amsterdam: Swets & Zeitlinger
- Rondeel, M. and Wagenaar, S. (2002). *Kennis maken: Leren in gezelschap* [Getting acquainted: learning in company]. Schiedam: Scriptum Management
- Rosenkopf, L. and Nerkar, A. (1999). Beyond local search: Boundary-spanning, exploration and impact in the optical disc industry. Working Paper
- Sanden, J.M., van der (2001). Opleiden vanuit constructivistisch perspectief [Education from a constructivist perspective]. In: Kessels, J.W.M., and Poell, R.F. (eds). *Human Resource Development: Organiseren van het leren*. Samson
- Sanden, J.M., van der, (1997). *Duurzame ontwikkeling van leervermogen: Leren leren in het technische domein* [Sustainable development of learning capacity: learning to learn in the technological domain]. Eindhoven: Technical University Eindhoven
- Schein, E. (1992). *Organizational culture and leadership*. San Francisco: Jossey-Bass
- Schein, E. (1993). On dialogue, culture and organizational learning. *Organizational Dynamics*, pp: 40-51
- Schilling, M.A., and Hill, C.W.L. (1998). Managing the new product development process. *Academy of Management Executive*, vol.12 (3), pp. 67-81
- Schön, D.A. (1983). *The reflective practitioner*. London: Temple Smith
- Schumpeter, J. (1961). *Capitalism, socialism and democracy*. Third edition. New York: Harper Torchbook Editions (originally published, 1942, by Harper and Brothers)
- Schutz, A. (1967). *The phenomenology of the social world*. Evanston, Ill. Northwestern University Press
- Senge, P. *The fifth discipline: the art and practice of the learning organisation*. London: Doubleday Currency
- Sol, H.G. (1982). *Simulation in information systems development*. Ph.D. dissertation, Groningen: University Groningen
- Star, S.L. and Griesemer, J. (1989). Institutional ecology: 'translations' and boundary objects. *Social Studies of Science*, vol. 19, pp: 387-420
- Stata, R. (1989). Organizational learning, the key to management innovation. *Sloan Management Review*, pp. 63-73
- Sternberg, R.J. (1997). The concept of intelligence and its role in lifelong learning and success. *American Psychologist*, vol. 52 (19), pp: 1030-1037

- Stewart, Th. (1997). Intellectual capital. *Nicholas Brealy Publishing Ltd, London Scandia Corporation*. In: Intellectual capital: value creating processes. *Supplement to 1995 annual report*, pp. 20.
- Strien, van P.J. (1986). *Praktijk als wetenschap* [Practice as science] . Assen: Van Gorcum
- Sundbo, J. (1997). Management of innovation in services. *The Services Industry Journal*, Vol.17 (3), pp. 432-455
- Sundbo, J. and Gallouj, F. (1998). *Innovation in services*. SI4S, S2, Step group
- Tan, J. (2000). 'Managing Knowledge – how to do it: a practical case study'. *The British Journal of Administrative Management*, vol. 19, pp. 12
- Teece, D. (2000). Strategies for managing knowledge assets. *Long Range Planning*, vol. 33, pp: 33-54
- Teece, D. and Pissano, G. (1994). The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change*, vol. 3, pp: 537-556
- Terziovski, M. (2002). 'Achieving performance excellence through an integrated strategy of radical innovation and continuous improvement'. *International Journal of Business Performance Management*, vol. 6, pp. 2
- Tsai, W. (2001). Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, vol. 44 (5), pp: 996-1004
- Tushman, M.L. and Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly*, vol. 31, pp: 439-465
- Tushman, M.L., and Rosenkopf, L. (1992). Organizational determinants of technological change: towards a sociology of technological evolution. *Research in Organizational Behaviour*, vol. 14, pp. 311-347
- Twiss, B.C. (1980). *Managing technological innovation*. New York: Longman
- Ulrich, D., Jick, T., von Glinow, M.A. (1993). High impact learning: building and diffusing learning capabilities. *Organizational Dynamics*, Autumn, pp. 52-66
- Utterback, J. (1994). *Managing the dynamics of innovation*. Boston, MA: Harvard Business School Press
- Venkatram, N. and Subramaniam, M. (2002). Theorizing the future of strategy: Questions for shaping strategy research in the knowledge economy. In: Pettigrew, A., Thomas, H., Whittington, R., (eds). *Handbook of strategy and management*. London: Sage Publications, pp. 139-164
- Volbeda, H.W. (1990). Een flexibele organisatie als voorwaarde voor innovatie [A flexible organization as a condition for innovation]. *M&O*, vol. 3, pp. 215-242
- Volbeda, H.W. and Bosch, F.A.J. (2004). *Rethinking the dutch innovation agenda: Management and organization matter most*. Essay for the Ministry of Economic Affairs' Innovation Lecture 2004. Rotterdam: Rotterdam School of Management
- Von Hippel, E. (1986). Lead Users: a source of novel product concepts. *Management Science*, vol. 32, pp. 429-39

- Vracking, W.J. (1992). Innovatie(management)vermogen verbeteren [Improvement of innovation potential]. In: Cozijnsen, A.J. and Vracking, W.J. *Ondernemen en vernieuwen*, Kluwer Bedrijfswetenschappen
- Vreede, G.J. (1995). *Facilitating organizational change*. Ph.D. dissertation. Delft: Delft University
- Walz, H. and Bertels, Th. (1995). *Das intelligente Unternehmen: Schneller lernen als der Wettbewerb* [Intelligent entrepreneurship: learning faster than competitors]. Landsberg/Lech: Verlag Moderne Industrie
- Weggeman, M.C.D.P. (1992). *Leidinggeven aan professionals* [Leading professionals]. Deventer: Kluwer
- Weggeman, M.C.D.P. (1997). *Organiseren met kennis* [Organizing with knowledge]. Scriptum Management
- Weick, Th. (1995). *Sensemaking in organizations*. London: Sage
- Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge UK: Cambridge University Press
- Windrum, P. and Tomlinson, M. (1999). Knowledge-intensive services and international competitiveness: A four country comparison. *Technology Analysis and Strategic Management*, vol. 11, pp. 391-408
- Wong, P-K, and He, Z-L, (2002). 'The impacts of knowledge interaction with manufacturing clients on KIBS firms innovation behaviour'. Discussion Paper No. 2002/69, WIDER, United Nations University
- Yin, R.K. (1984). *Case study research: Design and methods*. Newbury Park: Sage Publications

APPENDICES

Appendix I: Criteria for preliminary determination of radical vs incremental innovation

	Incremental innovation	Radical innovation
Contents	Description of the contents of the innovation	Description of the contents of the innovation
Criteria	<ul style="list-style-type: none"> ▪ Is related to existing methods, techniques or insights ▪ Is a renewal of existing methods, techniques or insights ▪ Is somehow recorded ▪ Is available for multiple application by a wider group of people ▪ Is used by others in their toolkit or process of service delivery ▪ Leads to some improvement of the competitive position of the firm ▪ Is created during the primary process on client demand 	<ul style="list-style-type: none"> ▪ Is not related to existing methods, techniques or insights ▪ Is the basis for the development of a new group of services or products ▪ Is recorded and well-founded, contains prototypes ▪ Is available to a wider community of professionals ▪ Is or can be used by a wider group of professionals ▪ Leads to a substantial improvement of the competitive position of the firm (or to enhanced professional status) ▪ Is a combination of renewal and more theoretical reflection
Judgement	Description and criteria based judgement	Description and criteria based judgement

Appendix II: Data collection protocol

The protocol contains:

- A. Procedures for the case study: orientation and access:
 - Review of preliminary information.
 - Check on suitability of the organization and the cases.
 - Check on access procedures.
- B. Determination of persons to be interviewed and other sources of information:
 - Guidelines for persons to be interviewed.
 - Guidelines for other sources of information.
- C. Questions for interviews (see appendix III):
 - Topics.
 - Questions.
- D. Analysis plan and case study report (Appendices IV to VI).

Ad A: Orientation and access

To make a proper selection of potentially useful cases and in order to check actual willingness of the organizations to participate in the study the following steps will be taken:

- Check whether organization is potentially interested (telephone conversation with involved CEO).
- Check relevance of case for the study:
 - Are there any innovations
 - What types of innovations
 - Can the organization be classified as a KISF
 - Relevance of the organization for the research (external validity)
 - In which phase of realization is the innovation
 - Are there enough sources of information
 - Are information sources objective
 - Does execution of the case study lead to possibilities for 'replication of logic' (cases for part 1) or is there room for possible interventions in the innovative process (cases for part 2)
- Check on willingness of organization to participate:
 - General willingness to participate
 - Availability of enough information sources
 - Availability of enough respondents for interviews
 - Willingness of respondents to participate in the interview
 - Consent for publication of case study and other information
- Study of special documents: study of documents that provide background information on access and suitability.

Ad B: Determination of persons to be interviewed and other sources of information

In order to obtain an overview of the strategic implications, but also of the innovative processes at the level of the organization, relevant groups and individuals it is necessary to interview the following actors:

- Members of the board/top management: *strategic setting and processes at the level of the organization.*
- HRM-manager: *Strategic setting, overview over the total of the process, influences of leadership and role of management, organizational conditions, possibly overview of processes at level of groups and individuals.*
- Initiator or 'key-person' of the innovative process: *cause for innovation, relation between incremental and radical innovations, overview of processes at the level of the organization, reflection on processes at the level of individual (own processes) and possibly at the level of relevant groups.*
- Relevant involved actors (having an active role in the processes or related to the process): *reflection on personal individual processes and processes at the level of relevant groups (these interviews can be held at the level of individuals and at the level of groups).*

Other possible sources of information are:

- Preliminary documents: ideas, strategic and tactic plans, startdocument, vision documents, requests for subsidies.
- Documents created during the process: project plan, intermediary reports, intermediary evaluations, meeting records and minutes et cetera.
- Final documents: blue prints, implementation plans, decision documents, end products, evaluation reports.

Appendix III: Questionnaire part 1

Innovation

1. What are the contents of the innovation?
2. What were the sources for the innovation?
3. Name comparable/related innovations/views/concepts that are used elsewhere?
4. Is the innovation recorded, where and in what way?
5. Is the information on the contents of the innovation available, for whom?
6. Do others use the innovation, who, where and how?
7. Has introduction of the innovation led to opening up of new markets or new groups of clients?
8. What were the effects of the innovation in terms of financial returns, number of users, benovolents et cetera
9. Has the innovation led to a wider reputation for the firm?
10. Has the innovation led to changes in views, vision or opinions in the professional community?
11. Has the innovation led to other changes in the organization (have other renewals been generated)?

Cognitive processes and information processing

1. What is our vision on the issue of the innovation; give some ideas, some views?
2. On what are these views, ideas based; what are important sources for vision, knowledge, views?
3. Are there fixed ways or patterns in your way of thinking when you are working on this issue; why is this; does it ever change; how and why?
4. Has your vision on the subject changed during the traject of renewal; can you point out what the differences are?
5. What was the reason for these changes; which sources where underlying these changes (e.g. own experiences in working on the issue, taking over existing knowledge and approaches, application of ideas that are being used elsewhere, experimenting with new ideas)?
6. Do you consciously use knowledge or visions from other sources in the development of the issue?
7. Was there a link between external and/or theoretical sources and your own experiences and insights on the related issue; was this link stimulated, how?
8. Did you change your view on what are important sources of knowledge/insights?
9. Do you see changes in your view or knowledge of the issue as gradual changes or as more fundamental changes? Can you explain?

10. What is the way in which you learn most about this subject or develop your knowledge; are there any changes in the way in which you learn and develop knowledge; what is the reason for this change?
11. What was your primary intention or goal at the start of the trajet (e.g. execution of a task, solving existing problems, developing a new vision by synthesis of existing and new ideas and concepts? Has your intention changed? In which direction?
12. What are the most beneficial factors for the development of your knowledge and vision on the issue?
13. What are the most impeding factors for the development of your knowledge and vision on the issue?

Socio-political processes and information processing

1. Who were the members of the team that developed/realized the innovation; What roles had did the different persons concerned; Were there other people around the team that were important for the team and the results of the innovative process; what was their role?
2. Was there a relevant network that played a role in the creation and/or realization of the innovation; Of whom consisted this network (internal/external; practitioners/other professionals)? How did the process of interaction develop in this network; What role did the network have in the realization of the final innovations?
3. How came the innovation team about; what are binding factors in the group?
4. What was the planned and actual goal of the team; were these goals realized; what was realized?
5. What is for you the most important effect of the innovative process; how is the team related to this?
6. What was the role of practical experience of the members of the team in the creation and realization of the innovation? Were these practical experiences comparable to each other of diverse?
7. What was the role of more theoretical insights and models in the creation and realization of the innovation? Did this concern existing views and models, new views and models or combinations between existing and new?
8. Was there a link between theoretical insights and models and practical experience; how was this link made; what was the effect of the link?
9. Were new insights and ideas tested against practical experience; where did this happen; who were involved; what was the effect?
10. Can you describe the process in terms of the following aspects:
 - Open – closed
 - Investigating – convincing
 - Equal – determined by dominant coalitions
 - Conformistic – open en inviting for deviant views
 - Focused on development of knowledge and vision – focused on problem solving

- Focused on divergence – focused on convergence
 - Focused on theory – strategy – practical experience
 - Focused on compliance to rules – on creating understanding – on development of theory:
11. Were there differences in power and status in the team; How were these handled; How were possible differences in opinion and view and conflicts handled in the team?
 12. Was there a clear leader: What were the reasons why this person had this position?
 13. What were the most beneficial factors for the process of the team? What influences did this have on the final product?
 14. What were the most impeding factors for the process of the team? What influences did this have on the final product?

Organizational conditions and role of management

1. Did actors in the innovative process dispose of the needed expertise and skills? How were these obtained?
2. Was an inventory made before the start of the innovative process of the necessary expertise and skills? How were expertise and skills obtained (e.g. training and study, external orientation; acquisition; internships)
3. Were teams composed on the basis of needed expertise and skills? Were teams multidisciplinary? What were the criteria for team composition?
4. What happens with new insights and experiences that are created during innovative processes? Are they identified and shared and used as learning experiences? Are they used for other processes and trajectories?
5. Is there a fixed plan for solving problems and generating ideas? Are deviations possible? Is it stimulated to reflect on the problem and look at it from different standpoints? How is this done?
6. Is there room for reflection in decision-making or problem solving in the innovative process? Is this stimulated or downgraded? Does this lead to new approaches?
7. Is management open for new and deviating ideas and approaches? Are these being used actively? Are professionals open for new and deviating ideas and approaches? Are these being used actively?
8. Is there room and space for research and analysis of the issue at hand? Is there room and space to develop new views? Does this lead to changes in output, in changes in approach and changes for the actors concerned?
9. Is there time for reflection in the process?
10. How is communication and interaction in the organization in relation to the innovative process? Is communication and interaction stimulated?
11. Is the organization part of and external network (formal and/or informal)? How is the network composed? What is the role of the network in the innovative process?
12. How is communication with the network and other external sources arranged? Who participates? Is participation facilitated and stimulated?

13. Are there centres of excellence in the organization related to the innovative process? Can involved employees participate in these centres? How is knowledge and insights from these centres shared?
14. What were the most beneficial organizational conditions and actions from management for the innovative process? What influences did this have on the final product?
15. What were the most impeding organizational conditions and actions from management for the innovative process? What influences did this have on the final product?

Appendix IV: Outline for case description

Subject	Contents
Organization	Short description of the organization Type of firm Profit or not-for-profit Primary process Other relevant characteristics Short background to the innovation and innovative process
Causes for change	Major internal causes for of set of the innovative process Major external causes for of set of the innovative process Background to the causes Major and first reactions to the causes for change Possible first implications of the causes
Innovation process	Chronological overview of the innovative process Actors involved Sources of knowledge and use and of these sources Effects of use of knowledge Concepts and influence of concepts Flows and streams of information and knowledge External liaisons and processes Internal liaisons and processes Processes within and between different groups of actors Flows and smoothness in the process Possible tensions, effects and ways to deal with these Role of management Relevant organizational conditions Other remarkable factors
Changes and results	Description of changes due to the innovative process Realization Internal and external effects of the innovative process Final results and consequences Actual situation in relation to the innovative process

Appendix V: Definition of codes

Inh:	Describes the contents of the innovation and a number of characteristics
Inh.inh:	Describes the contents of the innovation.
Inh.vern:	Describes the degree of newness of the innovation.
Inh.real:	Degree and way in which the innovation is realized.
Inh.mapos:	Effect of the innovation on the market position of the organization.
Inh.naam:	Effect of the innovation on the reputation of the firm.
Inh.doc:	Describes recording of innovation in documents or other ways.
Inh.gen:	Describes the degree in which the innovation can be generalized outside the organization.
Inh.toep:	Describes the degree in which the innovation can be used by others.
Inh.toegank:	Describes the degree in which the innovation is accessible for others.
Inh.vern:	Describes the degree in which the innovation forms the base for development of a wider range of renewals.
Inh.vra/proc:	Describes the degree in which the innovation stems from client demands .
Inh.best:	Describes the degree in which the innovation stems from existing approaches or insights.
Inh.prot:	Describes the degree in which the innovation contains prototypes of (theoretical) concepts.

Cog: **Describes the cognitive processes, learning and information processes that related to the innovation**

Theory of practice

Cog.ver.int:	Degree in which changes in vision/knowledge occur that fall within existing frames of reference.
Cog.ver.ext:	Degree in which changes in vision/knowledge occur that fall outside existing frames of reference.
Cog.metacog:	Degree in which meta-cognitive skills are being used.
Cog.onmeta:	Degree in which only cognitive skills are being used.

Epistemological domain

Cog.bron.pra:	Degree in which sources of used knowledge root from own experiences and situations in practice.
Cog.bron.the:	Degree in which sources of used knowledge root from theories and models.
Cog.bron.int:	Degree in which sources of used knowledge lie within the organization.
Cog.bron.ext:	Degree in which sources of used knowledge lie outside the organization.
Cog.bron.toe:	Degree in which knowledge and issued are applied.
Cog.interact:	Degree and way in which interaction between theoretical en practical knowledge occurred.

Learning strategy

- Cog.ls.verbet: Learning style focused on improvement of the existing.
- Cog.ls.acq: Learning style focused on acquisition of competences.
- Cog.ls.exper: Learning style focused on experimentation.
- Cog.ls.bound: Learning style focused on boundary spanning (using experiences and approaches from other organizations).
- Cog.ls.rest: Other learning styles used.

Goal orientaton

- Cog.doel.pro: Learning activities aimed towards problem solution.
- Cog.doel.taa: Learning activities aimed towards task accomplishment.
- Cog.doel.ken: Learning activities aimed towards creation of new knowledge, visions or concepts.

Int. Describes the formation of groups, interaction and dialogues that are part of the innovative process

Processes between groups

- Int.gr.ontw: Degree in which the group focuses on development of knowledge, vision.
- Int.gr.sel: Describes the selection process for members of the group.
- Int.gr.uitw: Degree in which the group focuses on exchange of knowledge, experiences, vision.
- Int.gr.binding: Degree and grounds for group ties.
- Int.gr.ondern: Degree in which the group is entrepreneurial.
- Int.gr.comm: Degree in which there is communication within and between different relevant groups.

Circles

- Int.circ.out: Degree in which there is a relevant group, consisting of members in- and outside the organization.
- Int.circ.strat: Degree in which there is a relevant group that functions at the strategic level.
- Int.circ.in: Degree in which there is a relevant group that consists of merely insiders functioning at the operational level.
- Int.circ.lid: Types of members of the different groups.

Communication

- Int.com.open: Degree in which the communication inside the group or between groups varies between open and closed.
- Int.com.oz: Degree in which the communication inside the group or between groups varies between investigating and convincing.

- Int.com.gelij: Degree in which the communication inside the group or between groups varies between equal or dominated by different coalitions.
- Int.com.conf: Degree in which the communication inside the group or between groups varies between conformistic or open for deviating opinions and views.
- Int.com.ken: Degree in which the communication inside the group or between groups focuses on knowledge and theory building or problem solving.
- Int.com.div: Degree in which the communication inside the group or between groups focuses on convergence or divergence.
- Int.com.theo: Degree in which the communication inside the group or between groups focuses on theory, strategy or practical experiences.
- Int.com.reg: Degree in which the communication inside the group or between groups focuses on compliance to the rules, enlargement of knowledge and insights or identity.
- Int.kop.th-p: Degree in which the group focus on linking theoretical views with practical experiences.
- Int.kop.toets: Degree in which the group focuses on testing new insights and views.
- Org.:** **Describes organizational conditions and roles of management that have an effect on the innovative process.**

Expertise

- Org.des.vrg: Degree and way in which is taken care of the availability of sufficient expertise and skills for the innovative process.
- Org.des.sam: Degree in which skills and expertise are represented in the different innovation teams.
- Org.des.ken: Degree in which relevant knowledge was brought in from outside.
- Org.des.del: Degree in which the organization stimulates sharing of knowledge and insights.
- Org.des.nut: Degree in which the organization stimulates identification and use of new knowledge and output from learning.

Reflection and problem solving

- Org.pro.rui: Degree in which there is room in the organization to approach problems from multiple sides.
- Org.pro.ler: Degree in which the organization helps employees to approach problems from multiple sides.
- Org.pro.lei: Degree in which management is open for new and deviating ideas.
- Org.pro.ref: Degree in which there is room in decision making and problem solving for interaction, reflection and dialogue and output from this is used.
- Org.refl.ver: Is there room and time for investigation and reflection in the innovative process.

Networks

- Org.nw.lei: Describes the role of the organization in the creation and participation in networks relevant for the innovation and innovative process.
- Org.nw.ic: Describes the role of the organization in the internal communication relevant for the innovation and the innovative process.
- Org.nw.coe: Degree in which the organizations stimulates the creation and existence of centres of excellence.
- Org.nw.cop: Degree in which the organization stimulates the creation and existence of communities of practice.

Appendix VI: Relation between coding scheme and data displays

Degree of success					
Criteria	Possibility to implement	Duration of life	Realization of goals	Considered success by relevant others	Realized pay offs
Codes	Inh.real. Inh.con Inh.new Inh.doc	Inh.real Inh.con	Inh.con Inh.new Inh.mapos Inh.naam	Inh.mapos Inh.naam Inh.toep	Inh.mapos Inh.naam

Character of the innovation				
Criteria	Basis for developments	New insights in the professional community	Generalization to the professional community	Status in the professional community
Codes	Inh.vern Inh.toep Inh.vra.proc Inh.best Inh.prot	Inh.naam Inh.mapos Inh.toepas Inh.vern Inh.prot	Inh.gen Inh.toegank Inh.toep Inh.prot.	Inh.mapos Inh.naam

Learning processes				
Criteria	Reflection/ conceptualization	Experience	Learning style	Goal orientation
Codes	Cog.ver.ext./int Cog.metacog./nonmeta Cog.bron.the/pra Cog.bron.int/ext Cog.interact	Cog.bron.the/pra Cog.bron.int/ext Cog.bron.toe Cog.interact	Cog.ls.verbet Cog.ls.acq Cog.ls.exper Cog.ls.bound Cog.ls.rest	Cog.doel.pro Cog.doel.taa Cog.doel.ken

Information processing				
Criteria	Knowledge acquisition	Knowledge interpretation	Knowledge distribution	Knowledge application
Codes	Org.bron.pra/the Org.bron.int/ext Org.des.ken	Cog.interact Cog.metacog/ Nonmeta Int.com.reg Int.kop.th-p Int.kop.toets	Int.gr.uitw Int.gr.comm	Cog.bron.toe Int.com.ken Int.com.theo

Socio-political processes: Between groups			
Criteria	Information exchange	Foundations for relations	Character of communication
Codes	Int.gr.uitw Int.gr.comm Int.cir.out	Int.gr.sel Int.gr.binding Int.circ.lid Int.com.gelij	Int.gr.ontw Int.gr.uitw Int.gr.ondern Int.com.open Int.com.oz Int.com.div Int.com.reg

Socio-political processes: Within groups			
Criteria	Relations	Goal orientation	Attitudes
Codes	Int.gr.ontw Int.gr.sel Int.com.open Int.com.gelij Int.com.div Int.circ.lid	Int.gr.binding Int.com.theo Int.kop.toets	Int.gr.uitw Int.gr.ondern Int.gr.onderz Int.com.conf Int.com.ken Int.com.reg

Role of management and organizational conditions		
Criteria	Room for reflection and meta-cognition	Stimulation of participation in external knowledge networks
Codes	Org.des.vrg Org.des.sam Org.des.del Org.des.nut Org.pro.riu Org.pro.ler Org.pro.lei Org.pro.ref Org.refl.ver	Int.circ.out Org.des.ken Org.nw.lei Org.nw.ic Org.nw.coe Org.nw.cop

Appendix VII: Within site displays case 1

Criteria	Documents	Interviews
<p>Degree of Success</p> <p><i>Possibility to implement</i> <i>Duration of life</i></p> <p><i>Realization of goals</i></p>	<p>Implemented conform plans; major logistic and substantial opposition existed; Still in execution; minor adjustments and improvements are made</p> <p>Implementation is conform original plans although pressure was exerted to minimize plans and bring plans in line with existing practice; Innovation is important contribution towards new concepts and approaches in the field</p>	<p>We are now working on the implementation We are still wondering whether we can implement it</p> <p>--</p> <p>Innovation is an important factor in contextual learning Innovation improves effectiveness and efficiency in (lifelong) learning Members of the National Quality Assurance Committee were enthusiastic We do not know but we have the impression this is one of the reasons why more students are coming The others in the professional field are looking at what we are doing We have started a development, but we aren't there yet We moved from 3rd place to 2nd place in terms of student preferences We do not know but we have the impression this is one of the reasons why more students are coming The others in the professional field are looking at what we are doing We do not know whether it means something for the strategic position of the hospital but it gives possibilities</p>
<p>Function</p> <p><i>Basis for developments</i></p> <p><i>New insights in professional community</i></p>	<p>Innovation forms as the constituting element the basis for a new concept on education in medical curricula (the Z-curriculum)</p> <p>--</p>	<p>We can transform it into a virtual hospital We are now thinking on the basis of the innovation about the improvement of the link between this program and the specialization program It leads to new strategic partnerships with other hospitals It is considered a landslide by others We are the first (except for 2 places abroad) who are doing this One other university is trying to copy us It may be a new concept for the interaction between pre-clinicians and clinicians It is a trend in the development of the H-curriculum towards the Z-curriculum We may be adding a little to professional developments Others are looking at us to learn from us We are talking about it at conferences</p>
<p><i>Generalization to professional community</i> <i>Status in professional community</i></p>	<p>--</p> <p>Model is considered unique in a national perspective</p> <p>--</p>	<p>The others in the professional field are looking at what we are doing On a national and an international level this innovation is considered remarkable I don't know if other teachers care</p>

Appendix VII-Display I: Success and function of the innovation

Actor	Circle	Reflection/abstractive processing	Experiences	Information processing activities	Learning style	Goal orientation
Dean	<i>Strategic circle</i>	<i>Medium</i> Vision has not changed I act on the basis of my own experience and reflection upon this You end up with a middle of the road approach between the view of the theorist and implementation The model fits perfect in a new theoretical framework	<i>High</i> I act on the basis of my own experience and reflection upon this The ideas about education in my 'home university' play a strong role	<i>High</i> We used the experiences and failures from other universities It is a continuum, everybody takes a step and uses the experiences from others and goes a step further	<i>Experimental</i> We used the idea that failed elsewhere and incorporated it in such a way that we succeeded <i>Boundary Spanning</i> We went to the others and used their ideas, and others will use our ideas	<i>Problem Solving</i> It wasn't good; it is a challenge to create a good method
Chairman of faculty board	<i>Strategic circle</i> Was introduced from another organization during the project	<i>High</i> There is too little knowledge in literature on our subject I want to use Kolbs' model more You build a holistic view and I use theory to understand it Reading and writing leads to new ideas	<i>Medium/low</i> I use theory, but I also try to use practical experience In the medical world I am a theory man	<i>Acquisition high; dis-tribution and application low</i> I want to use Kolbs' model more I get some ideas while reading Someone worked it out for another field and we should try to use that	<i>Experimental</i> I would like to intermingulate theory and practice more and do some research on that I will give a speech about the subject and see how they react Someone worked it out for another field and we should try to use that	<i>Personal knowledge building</i> It is a challenge to do something new, integrate theory <i>Problem Solving</i> Give us the problem and we will solve it
Innova-tor/Chairman Of curriculum committee	<i>External circle</i> Strategic position as chairman External position as introduced from outside	<i>High</i> That's my way of thinking I associate and combine and an new idea comes up I search for inspiration and flexibility I show clouds and slowly contours and concepts develop I think diffuse, associative I associate the theoretical view with earlier experiences	<i>Medium</i> And we have a phase where we clash with reality and we compromise I learn from my experiences Practical experience slows down I you do something new, don't let practical experience nibble too much away from it	<i>High</i> I read a lot about the subject I use the experiences from others I listen to others and produce contours and concepts out of that We develop concepts into application	<i>Experimental</i> I went to a man from industry and after that I learned from the department of scenario building from a research institute I associate theoretical views with earlier experiences <i>Boundary spanning</i> I used the ideas from another university	<i>Personal knowledge building</i> I want to develop new concepts Developing is a way of live

Actor	Circle	Reflection/abstractive processing	Experiences	Information processing activities	Learning style	Goal orientation
Sr. staff member/ member of c.c.	<i>Internal circle/strategic circle</i> Internal as a member of the workforce Strategic as a member of the committee	<i>Medium</i> I haven't done homework and haven't immersed myself in it I find it hard to read about learning, but I have ideas about what people say about it I can explain it to others and work from the fundamentals of the concept Our primary task is logistic Did develop an model on the basis of his own experience and the developed concept	<i>High</i> I was disappointed about what happened here and using the experiences from others and being practical we developed the idea I am now busy implementing the concept and we are looking at the actual possibilities We are now looking at how the others are doing it	<i>Low knowledge acquisition/ High distribution and application</i> I haven't done homework and immersed myself in it I explain the concept and the fundamentals to the others I am now busy implementing it	<i>Boundary spanning</i> I developed some models on the basis of what we saw elsewhere <i>Continuous improvement</i> I was so disappointed about the way we used to organize the clerkships We are now working with two others who experimented within the old framework in their own unit, new plans, other ideas, testing Our primary task is logistic	<i>Problem Solving</i> The fundamental thing is solving the problem and not performing a task
Project manager	<i>Internal circle</i> Is no member of the committee (but sits in)	<i>Low</i> Before we start to change the whole concept again, let's try twice the concept we developed	<i>High</i> My experience is that you learn more from experience than from reading a book Common sense and experience were more influential than models	--	--	--
Jr. staff member/ member of working group	<i>Internal circle</i> Member of the workforce	<i>Low/medium</i> I read about it and learn how you can implement it better I Haven't changed my view	<i>High</i> I don't have much knowledge about education, most of it is based on my own experience We visited the others to see how they are doing it I used my own practical experience to implement it	<i>Medium knowledge acquisition, low distribution, high application</i> I read some articles about it We had a conference with the other university hospitals I am implementing the idea, we look at how others implement it	<i>Boundary spanning</i> We used the idea from another university hospital to use the general hospital as educational settings <i>Continuous improvement</i> Our goal is to improve it	<i>Task Oriented</i> The main goal is executing the assignment

Appendix VII- Display II: Learning model and information processing

		Between groups			Within group		
Actor	Circle	Information exchange	Foundations for relation	Character of communication	Relations	Goal orientation	Attitudes
Dean	<i>Strategic circle</i>	<i>Open/High</i> They others are informing themselves The others were very constructive open and willing to share their knowledge	<i>Open/Added value/knowledge</i> They appreciate that their knowledge is valued	<i>Open/Dialogue</i> They share in vision development and evolution of ideas	<i>Closed/open</i> We selected the members on the basis of their position and representation of several groups We selected the members on the basis of their attitude towards education The innovator has a lot of knowledge	--	--
Chairman of faculty board	<i>Strategic circle</i> <i>External circle</i> Was introduced from another organization during the project	<i>Open</i> A community of practice develops that shares views and knowledge	<i>Open/closed</i> They all come through a course I do	<i>Open</i> We share our ideas	--	--	<i>Closed/open</i> In a certain sense there is a dialogue, but in the other sense there is not
Innovator/Chairman of curriculum committee	<i>External circle</i> <i>Strategic circle</i> Strategic position as chairman External position as introduced from outside	<i>Open/closed</i> We all share the latest knowledge I selected my own network They are all friends of mine	<i>Open</i> We all share our latest developments They gave me information I select the others on their knowledge	<i>Open</i> We read the same books and share the same information	<i>Closed</i> It wasn't a group, but we selected them	<i>Open/closed</i> We developed the concept with this group The others confirmed me more, I developed the ideas	<i>Open/closed</i> There was a dialogue about the ideas We safeguard the idea that was developed We integrated new ideas
Sr. staff member/ member of c.c.	<i>Internal circle</i> <i>Strategic circle</i> Internal as a member of the workforce Strategic as a member of the committee	<i>Closed/open</i> We communicate a lot We have to inform them about our goals	--	<i>Open</i> We work together with someone who wrote a winning report and we developed the idea	<i>Open/closed</i> We selected them because of their identification with education The committee talks about the way the goals can be implemented	<i>Open/closed</i> Our main commitment is doing our job, in that we have a groupspirit Everybody has the opportunity to bring in his own ideas	<i>Closed</i> I took very apodictic a few positions We are the apostles

		Between groups			Within group		
Actor	Circle	Information exchange	Foundations for relation	Character of communication	Relations	Goal orientation	Attitudes
Project manager	<i>Internal circle</i> Is no member of the committee (our sits in)	<i>Closed</i> We discussed it but we did not change our ideas	--	<i>Open/Closed</i> They developed the blueprint and others are implementing it In the begin it was open later it became more closed	<i>Open/Closed</i> The members of the c.c. were asked because of their strategic positions, in order to get the strategic commitment of others They share what they develop	<i>Open/Closed</i> Sometimes they are rather dogmatic, they stick to their own ideas They are geared towards knowledge development	<i>Open/closed</i> In the beginning they were more investigative, later they became more closed, aimed at convergence
Jr. staff member/ member of working group	<i>Internal circle</i> Member of the workforce	<i>Closed</i> The curriculum committee holds on to their ideas They preach the gospel	--	<i>Closed</i> The others have developed the idea	<i>Open</i> They were asked because of their own experiences Some are closed others more open, but all were asked because of their experience We are all equal	<i>Open</i> It is very open, everybody can say what he wants	<i>Open/closed</i> We investigate, but still the leaders whine about their ideas We converge, because of time pressure

Appendix VII-Display III: Socio-political processes

Actor	Circle	Room for reflection and metacognition	Stimulation of participation in knowledge networks
Dean	<i>Strategic circle</i>	<i>Medium</i> We started with some 'legs on the table' discussion, but in general there was quite a lot of time pressure. In the beginning there was time for reflection, but now we don't have time for that	<i>Low</i> Introduction of the chairman of the faculty board was deliberately done to introduce both power and high level proven knowledge about educational insights
Chairman of faculty board	<i>Strategic circle</i> <i>External circle</i> Was introduced from another organization during the project	<i>Medium</i> In some sense there is a dialogue, but at the same time there isn't	<i>Medium</i> I had some new ideas that we shared We do intend to create communities of practice Some people express their ideas in external knowledge networks
Innovator/Chairman Of curriculum committee	<i>External circle/strategic circle</i> Strategic position as chairman External position as introduced from outside	<i>Low</i> In general management is not very open to new, deviating ideas The dean was open	
Sr. staff member/ member of c.c.	<i>Internal circle/strategic circle</i> Internal as a member of the workforce Strategic as a member of the committee	<i>Medium</i> In the beginning of the project there was time for reflection, but now the train is high on steam	
Project manager	<i>Internal circle</i> Is no member of the committee (but sits in)	<i>Medium</i> The committee is a sort of learning group, but we don't state that explicit	
Jr. staff member/ member of working group	<i>Internal circle</i> Member of the workforce	<i>Medium to low</i> The committee is much more open minded than the workforce There is some form of reflection, but as time goes by new ideas are less welcome We are not able to reflect on our own work yet	<i>Low</i> Some new ideas that were brought in we discussed but did not introduce them

Appendix VII-Display IV: Organizational conditions

Appendix VIII: Questionnaire part 2

The interviewees are all interviewed by face-to-face discussions. These one-hour interviews were guided by a partly structured questionnaire, which was tailored according to the function of the interviewee. Changing emphasis to specific subjects with certain interviewees. The list of interviewees and the summaries of the interviews are enclosed in a separate document, since it contains confidential information.

General

1. Start of the process, causes to change the curriculum.
2. Experience with such big changes and level of knowledge required to accomplish this innovation? Available internal or external?
3. What did the innovation include?
4. Was there enough commitment and foundation within the organisation to create and implement such an innovation?
5. Which effects did the thorough change of the education programme had on the Faculty of Pharmacy? E.g. numbers of students, image (within/outside the faculty/university), atmosphere?
6. How should a radical innovation be directed, top-down or bottom-up?
7. Do you consider the curriculum renewal as a success? Based on which arguments?
8. Do you consider the curriculum renewal as radical? Based on which arguments?
9. What are the external reactions to the curriculum renewal, does the external community consider it as a success?

Situations faculty

1. How did the old situation look like and how did it function? Specify on the base of:
 - core values and philosophy of the education programme
 - built-up of the curriculum
 - integration of the curriculum and its organisation
 - incorporation of innovation and improvement
 - organisational structure.
2. How does the current situation look like and how does it function? Specify on the base of: see above.
3. How should the desired situation look like and how should it function? Specify on the base of: see above.

Steps

1. Which steps, in chronological order, are taken in the process of the curriculum renewal?
2. Is a concept designed which functioned as the base for the new education programme? Did this change along the process?
3. How was the renewal diffused within and outside the organisation? Did the employees had the possibility to participate?
4. Was the change supported by the management of faculty and/or university?
5. Which problems came forward during the process of innovation?
6. Has it been necessary to do a step back in the process, e.g. due to a lack of commitment?

Actors

1. What has been your role in the curriculum renewal?
2. Who were the key persons during the innovation? How was the project team configured and caused this configuration problems for the process of change?
3. Which other groups, than the project team, were important for the result of the innovation process? How was the curriculum renewal organised?
4. Was the necessary level of competencies and capabilities in place at the involved persons? If not, did they get sufficient training get rid of this lack? On which base was a team configured?
5. Did a relevant external network exist during the change process and what was its role?
6. Can you describe the way of interaction and communication? Has there been good communication and cooperation?
7. Describe the processes within and between the groups involved in the change process. Changed this during the process?
8. In what way could people participate in the curriculum renewal? E.g. to gain commitment and foundation, posing good and refreshing ideas

Socio-political processes

1. Existence of (a group of) actors with a lot of influence on the process of innovation? What was their influence and how dealt/responded other actors?
2. Nature of decision making, how and on which base are these made?
3. Existence of resistance during the process, in relation to the phases. Which actors resisted and with what reason? Is this resistance used for putting arguments forward and explain the reason for change and therefore turn this resistance into commitment?
4. Did conflict situations occur during the process, when, about what and who were involved?
5. Possibilities to arrange certain things informally, instead of in a formal way?
6. How would you characterise the communication within certain groups, between groups, and within and outside the organisation? Did it change along the innovation process?
7. In which way were people informed and involved about the developments around the curriculum renewal?
8. How was the exchange of information arranged, within and between groups? Was everybody kept informed?

Information processing activities

1. Presence of different levels of knowledge of the actors in the innovation process? Was this recognised with the configuration of the teams, e.g. getting extra training?
2. Diversity of types of knowledge: 'hard' figures (explicit) and personal information (tacit)? Which was most important and in which phase?
3. Could steps be identified in relation to the knowledge conversion process? How was new knowledge developed? Knowledge exchange?
4. Way of dealing with 'saving' and exchanging knowledge in the organisation? Was this stimulated?

Learning processes

1. What is the policy of the faculty in the field of learning and innovation within the organisation, e.g. training and educating people?
2. Did an exchange of experiences exist during the process, to learn from each other, in relation to the phases? Was this stimulated? In what way are these experiences incorporated in the organisation?
3. Is a stimulation/punishment of creativity and generating of radical and new ideas? Stands the management open for new and fresh ideas and opinions? What would be done with these ideas and opinions?
4. In what way were the employees motivated to perform well during the curriculum renewal and beyond?
5. What happens with the knowledge gained from these experiences of such change processes?

Organisational conditions

1. Were there points of reflection during the process, e.g. on goals, approach etc? Dialogue and acceptance of differing ideas during the process?
2. Stimulation and mobilisation to share knowledge within the organisation

Pitfalls

1. Has the whole business model been reviewed at the start of the innovation process?
2. How is the organisation structured, formal and informal and its difference? Did the new curriculum require a new structure? Difference between the old and current situation?
3. Is an organisational network present, consisting of other organisations and institutions? Is communication and exchange of information accomplished during the renewal and afterwards?
4. Did the involved actors learn from the renewal, for example, dealing with future developments in an other way? Change of working method?
5. Name some words which symbolise the organisational culture of the Faculty of Pharmacy. Difference between before and after the curriculum renewal?
6. How is the renewal secured in the current structure of the organisation?

SUMMARY

The aim of this study is to develop a process design model and practical design components for the development and realization of radical innovations in Knowledge-intensive service firms (KISFs).

There is a growing need for KISFs to create new knowledge and, especially, to innovate. It is increasingly difficult for KISFs to prove their surplus value. Professional and complex knowledge is becoming more and more widely available. As a consequence not only competition between knowledge firms is increasing, but, even more important, knowledge gaps between specialists and their clients are being greatly reduced. In order to deliver their surplus value the core-competence of KISFs has to change from the ability to acquire and apply knowledge into the ability to create innovative ideas and transfer those ideas to action faster than their competitors.

Up till now there is little understanding of how radical innovations are created in KISFs. Not much research has appeared on this issue. Quite some research has been performed on innovation in manufacturing industries. Due to the major differences between manufacturing industries and KISFs, however, it is not obvious that findings from this research can be applied to innovation in KISFs. As a consequence there is little insight into a major and growing core-competence of an industry that is increasingly important: there is a strong need to develop more understanding of the process by which radical innovations are created in KISFs.

KISFS

In the 20th century service industries have rapidly increased in terms of their contribution to economic growth. This is caused both by the increasing importance of the service industry in general and by the increasing need to base the competitive value of the western world on knowledge intensive activities.

By KISFs we mean *'firms that provide services to clients, where these services are based on knowledge that is complex and non-routine in character, and where well-educated, qualified employees form the major part of the workforce.'*

The character of the primary process of KISFs and the character of the knowledge workers that work in these firms, account for a number of impediments for the creation and application of radical innovations:

- a. The importance of the development of *individual intellectual capital*:
 - The emphasis in knowledge development and innovation lies with individuals or groups of individuals: it is often not possible to specify the output of the primary process beforehand. As a consequence the creation of innovations cannot be imposed.
 - New knowledge is often restricted as it is created during individual contacts with clients that are based on existing paradigms in the primary process. As a consequence knowledge stays within existing frames of reference.

- Knowledge workers base their position on high levels of competence in their own knowledge base, as a consequence they find it hard to accept new technologies that are imposed from outside.
- b. Impediments for the creation of *collective radical intellectual capital*:
- Transfer of new knowledge to the KISF is difficult as creation of this knowledge takes place on client-location.
 - (Collective) radical innovations lacks behind as the dominant mode of innovation in KISFs is incremental: innovations are mainly (restricted) improvements and re-inventions in the primary process.
 - The major influence of dominant coalitions of knowledge workers on decision making process in the organization hampers the introduction of new technologies and insights. The dominant coalition will tend to prevent the introduction of radical innovations as this may decrease their control of the primary process and as a consequence their position and power in the firm.

On this base it can be concluded that KISFs are often far less innovative than potentially possible. This may reduce their competitiveness unnecessarily.

Radical innovation

Innovations are often described in terms of their amount of newness. However due to the high 'software character' of innovations in the service industry the amount of newness may be hard to define. Next to that, the process of application of innovation in KISFs is a continuous process of re-invention and improvement leading to continually evolving 'products' This makes it difficult to define an innovation in terms of a 'steady end state'. The essential function of innovation is not so much the degree of newness, but its contribution in terms of the added value for clients and others, and thus its contribution to the improvement of the competitive position of the firm. Successful radical innovations in KISFs are often new combinations of existing concepts or applications of existing concepts in (fundamentally) new markets. We define radical innovations as '*innovations based on fundamental changes in underlying concepts or technologies that lead to sustained competitive advantage*'.

Research Questions

The aim of this study is to develop a prescriptive model and validated design components for the creation and application of radical innovation. In order to accomplish this, the study addresses the following research questions:

1. What are the processes that lead tot the creation of radical innovations in KISFs?
2. What are the characteristics of the different phases in the creation of these innovations?
3. What is the role of management and the organizational conditions that facilitate the creation of radical innovations?
4. Can the process of creating radical innovations be influenced by an adequate application of the process design model for radical innovations?

Methodology

The research project is divided into two parts:

Part 1: Descriptive:

- Development of a conceptual framework on the basis of a literature study.
- Case study of a successful and unsuccessful radical innovation.
- Development of the conceptual framework .
- Case study of a successful and unsuccessful radical innovation.
- Development of the conceptual framework.

Part 2: Prescriptive:

- Development of the process design model and practical design components.
- Case study: application and testing of the process design model.
- Final process design model and design of final heuristics for radical innovative processes.

Conceptual framework

A. *Innovation management*

There are a number of similarities and differences between innovation process in manufacturing and in KISFs. The most striking difference is the absence of R&D departments in most KISFs and the fact that mostly ‘performing professionals’ have a crucial role in innovations. Partly due to these two characteristics of KISFs it has long been presumed that the innovative process in KISFs is the sum of continuous incremental innovations that take place during service delivery. However, insights from literature show that incremental and radical innovations are based on two different processes. This means that radical innovations in KISFs are not the result of a sum of incremental innovations but are rather created by more ‘reflective and abstract R&D processes’. Due to the absence of R&D departments in KISFs these reflective and abstract processes are based outside more classical R&D sites.

B. *Knowledge management*

Much of the ‘classical literature’ on knowledge and knowledge management focuses on the use and reuse of knowledge and the efficiency in this process (stock- and flow strategies). In this view knowledge development is restricted to existing frames of reference. However, radical innovation has to be based on insights from ‘growth strategies’ geared towards knowledge development that takes place outside existing frames of reference and that has an explicit focus on the acquisition and creation of new knowledge. In this process the emphasis lies on reflective and conceptual knowledge development (‘embrained knowledge’) and far less on the development of action oriented knowledge and the creation of shared understanding (‘embodied’ and ‘encultured’ knowledge). In the creation of embrained knowledge the interaction between relevant external networks and (internal) ‘communities of practice’ is of great importance. As a consequence it is hypothesized that the creation of radical innovations in KISFs is based on a combination of ‘epistemologies of practice’ (exchange and development of knowledge in the primary process) and more explicit information processing activities geared towards acquisition and processing of external knowledge.

C. Learning in organizations

The role of learning processes in innovation is fundamental. On the basis of existing literature three levels of learning can be discerned: reproductive learning, productive learning and explorative learning. Radical innovations are based on explorative learning. Three main approaches to learning are 'cognitivism', 'social construction', and 'experiential learning'. Social construction as an approach may account for the interactive and negotiation component that is essential for innovation in KISFs, but its tendency towards bounded rationality may fall short of the creation of radical innovations. Cognitive learning at the level of model 2 learning may account for the needed amount of conceptual development in radical innovations, but falls short of the interactive processes that take care of the socio-political processes in innovations in KISFs. The experiential learning style seems to offer a view on learning that is suitable for innovation at all levels since it includes both experience in the primary process and reflection and abstraction. The creation of radical innovations, however, demands a combination of experiential learning processes with explicit knowledge acquisition focused on the introduction of new technology that lies outside existing frames of reference. 'Subjective learning theory' with its four elements ('the theories of practice', epistemological opinions', 'learning strategy' and 'goal orientation') provides a clear framework for a more in depth study of learning processes in radical innovation.

D. Socio-political processes

Radical innovative processes are determined by both learning processes geared towards acquisition and introduction of 'new' technological or methodological paradigms and by socio-political processes. These socio-political processes determine the degree in which the dominant coalition in KISFs is willing to exchange existing (and mastered) competences for new (and not yet mastered) competences that are inherent to radical innovation. Impeding elements for this exchange are not only the fear of loss of professional autonomy of the knowledge worker, but also the threat of loss of control of the primary process (during the first days of new paradigms in the primary process the knowledge working will be temporarily incompetent). Gatekeepers, as importers of new paradigms, often have a low degree of acceptance within the dominant coalition. Socio-political processes in KISFs induce a bias towards incremental innovation and a rejection of radical innovations. This may pose a threat towards loss of competitive advantage in the longer term. Successful radical innovation will thus ask for a strong management of the socio-political processes in KISFs.

E. The role of management and organizational conditions

The role of management is restricted to a facilitative one rather than a steering one. In the first phases of innovation the emphasis will be on strategic recognition, market orientation, and sourcing of creative ideas. In later phases the emphasis will be on the acceptance and leverage of subsequent innovations. Important organizational conditions are the ability to participate in knowledge networks and creation of room for reflection and the development of reflective and meta-cognitive abilities.

CASES PART 1

The descriptive part of the study concerned four case-studies executed in two KISFs: a university (not-for-profit) and an architectural firm (profit). In both firms two cases were studied. Data analysis showed that the cases complied to the criteria for respectively successful and unsuccessful innovation. The effect of the innovative process in terms of success or non-success was re-

lated to learning processes, information processing activities, socio-political processes and the role of management and organizational conditions. The successful cases showed a consistent pattern as far as learning processes, information processing and socio-political processes were concerned. The pattern was less clear for the role of management and organizational conditions. The patterns in the successful case were different from the patterns in the unsuccessful cases.

Process design model and practical design components

The results of the case studies, the theoretical framework and supplementary literature study formed the empirical and theoretical base for a process design model and heuristic guidelines (practical design components) for the development of radical innovations in KISFs.

CASES PART 2

The process design model and the practical design components were applied in a case study that was aimed to a radical innovation in the curriculum of an educational institution of a university. The innovation concerned a fundamental change of a major part of the primary process of the organization. In the innovative process the process design model and the heuristic guidelines were applied (some in first instance, others only in second instance). The effect of the application of the guidelines was in line with the proposed effects: application of the practical design components led to a successful radical innovation in a KISF. It has to be taken in mind, however, that some more solid proof for the radicality of the innovation still needs to be given in the coming years.

SUMMARY OF THE RESULTS

As far as the limitations for the research allow, the answers to the research questions are:

1. *What are the processes that lead to the creation of radical innovations in KISFs?*

The process of radical innovation in KISFs can be distinguished in three phases: (1) idea generation, (2) crystallization and (3) evolution. These phases are named after the most important characteristics of these phases. In all phases there is an important role for:

- a. *Learning processes* that play a role especially in the idea generation and evolution phase.
- b. *Information processing activities* that play a role in all three phases.
- c. *Socio-political processes* that play a crucial role in the crystallization phase.

Apart from the differences in importance per phase, there are also differences in the character of these elements in all three phases. Per phase different (groups of) actors play an important role in the creation of radical innovations.

2. *What are the characteristics of the different phases in the creation of radical innovations in KISFs?*

The phases can be discerned in terms of the processes taking place and the output in both contents and process they create. As far as the *sequence of the phases* is concerned, there is a need to finish a preceding phase in a satisfactory way before entering the next phase. It has to be

checked whether the innovative output of a phase is realized at an adequate level before the next phase can be properly started. This is the case, especially, in the transfer between the crystallization to the evolution phase.

In terms of characteristics the phases can be described as follows:

- *Idea generation phase:* Outputs are basic ideas for the underlying concept of the innovative process. Main processes in this phase are the acquisition of new knowledge from external knowledge networks, reflection and conceptualization on this knowledge in relation to the innovative issue at hand, and experimentation with new knowledge (in interaction with reflection and interaction). The goal orientation is based on a drive towards knowledge building rather than towards problem solving. Interaction between participants in the knowledge network can be described as a 'virtual R&D-site'. Main actors in this phase are gatekeepers, who have access to external sources of knowledge and who are able to import this information into the organization. These gatekeepers may act as innovators or may work in combination with innovators. In general gatekeepers and innovators have a low degree of acceptance in the organization, except when they have a leading role as manager or founder of the organization. Other members of the organization have little or no role in this phase
- *Crystallization phase:* Output of this phase is a reified core concept that is agreed upon by both gatekeepers and opinion leaders from the dominant coalition of professionals (or by opinion leaders from relevant external parties or decision makers in the firm). These opinion leaders act as boundary spanners that play an essential role in acceptance of new knowledge and concepts from the external knowledge network by members of the firm. Main constituting processes in this phase are the socio-political processes between gatekeepers and boundary spanners and information processing activities aimed at collective interpretation of new ideas and knowledge by gatekeepers and boundary spanners. Socio-political processes are aimed towards the building and negotiation of a core concept that can function as a new paradigmatic frame of reference for the organization. These negotiations are generally conflictive as gatekeepers tend towards far fetching ideas and boundary spanners strive towards affirmation of experiences of the dominant coalition and adaptation towards existing views. Effective boundary spanners are both accepted informal leaders within their own group and are innovative. Top management has an essential role in managing the political process amongst boundary spanners and gatekeepers. After the core concept is created and agreed upon, the group of boundary spanners steers the dominant coalition in the firm towards re-interpretation of experiences in the primary process within the context of the new frame of reference. The core concept has to meet a number of criteria. It has to be sufficiently unambiguous to stand out as a clear concept for the rest of the process. At the same time it has to be stated at an adequate abstract level in order to provide sufficient room for the executing professionals to create actual innovations and innovative artefacts. Core concepts that are either too strongly prescriptive or that are 'pseudo crystallizations', that lack clearness and agreement, are lethal to the actual realization of radical innovations.
- *Evolution phase:* Output of this phase is a continuous stream of innovative artefacts that fits in with the core concept/new frame of reference. In this phase a process of incremental innovation flows from the radical process that took place during earlier phases. Major processes in the evolution phase comprise the processing of knowledge in order to

create continuous improvements and incremental innovations within the new frame of reference. Information processing is aimed at the distribution of the core concept, distribution of new insights that are formed by placing experiences in the primary process in the new framework, and at application of these insights in order to realize actual innovations. The information processing activities are combined with learning activities focused on continuous improvement and the processing of experiences aimed towards the solution of actual problems and task completion. Major actors in this phase are the boundary spanners who now act as the ambassadors for the core concept. These boundary spanners test realized innovations in terms of their fit with the new frame of reference in order to prevent re-appearance of the former paradigm. Other major actors are the executing professionals who develop the actual innovations during the primary process and who sell the innovation to clients.

3. *What are the organizational conditions that facilitate the creation of radical innovation?*

Although this aspect was not explicitly included in the research, it can be deduced from the findings that organizational conditions and a facilitating role by management certainly have an influence on the creation of radical innovations:

- *Idea generation:* The main role of management is strategic recognition: (A) recognizing the need for radical innovation and creating room for idea building by not focussing on (short term) outcome oriented performance measures for gatekeepers and innovators. Balancing between the need for long term value creation and short term capital destruction. (B) Ability to recognize gate keepers, innovators and external knowledge networks that can generate valuable ideas for radical innovation in the long term, and selection of strategically valuable virtual R&D-sites. (C) Ability to select ideas for further development that create value and are enriching for available competences, selection of ideas that are capital enriching rather than capital destructing. Management also has a leading role in creating conditions for virtual R&D-sites: enabling (potential) gatekeepers and innovators to create networks or participate in existing networks; creating room for reflection, conceptualization, experimentation and personal knowledge building.
- *Crystallization:* the major role of management is enlargement of absorptive capacity. In this phase there is a role for senior management especially. The emphasis is on identifying boundary spanners who are capable of handling the split between radical innovation and the tendency towards preservation of existing patterns and processes by the dominant coalition. Top management has a managerial role in facilitating political negotiations and collective interpretation between gatekeepers and boundary spanners. They also play a role in protecting the 'degree' of radicality of the innovation. Related to this is the choice by management towards either incorporation of the innovation in the own KISF or into a 'spin off'.
- *Evolution:* The role of management focuses on the creation of a learning environment for knowledge workers where incremental innovation and continuous improvement can take place: a structure and a culture that provide knowledge sharing and 'small scale experimentation'. Next to that a role in testing conformance of the primary process towards the new frame of reference.

4. *Can the process of creating radical innovations be influenced by adequate application of the process design model for radical innovations?*

The research project shows that adequate application of the heuristic guidelines leads to better results in terms of radical innovations as compared to innovative processes where the practical design components were absent (the unsuccessful cases). Proper application of the model contributes to the creation of radical innovations. However, it has to be emphasized that the guidelines are heuristic rather than algorithmic. Adjustment of the guidelines, in correlation with the differences and similarities with the case in part two of the study, is needed.

Relevance of general innovation theories for KISFs

There are three main differences between innovation processes in manufacturing and in KISFs. In manufacturing idea generation and prototype development often takes place in a separate R&D-setting. In KISFs idea generation takes place in virtual R&D-sites consisting of one or a number of members of the organization and the external knowledge network in which they participate. Next to that there is a much stronger influence of socio-political processes on the success of radical innovation in KISFs than in manufacturing industries. The role of these socio-political processes is crucial especially in the crystallization phase. The actual realization of innovations in KISFs is materialized during the primary process by the community of executing professionals, where these professionals have a major role in determining the final shape and character of the innovation. To provide room for this, the underlying core concept has to be defined at an adequate level of abstraction. This in contrast to prototypes in manufacturing that are more specified and defined.

Radical innovation as change management

Processes of radical innovation have much in common with more general fundamental change processes. A comparison of the process of radical innovation with the 'colour-model' of change, shows that each of the three phases in radical innovation can be characterized in terms of a dominant change-colour. The idea generation phase is dominantly white, with an emphasis on self chosen, autonomous change that is dynamic, anchored in experiment and dialogue, and meta-paradigmatic. The crystallization phase is yellow, with its emphasis on socio-political processes where change is realized by negotiation between different parties with conflicting interests. The evolution phase is mainly green with a focus on collective learning.

Radical innovation as knowledge economies

On the basis of the process design model the different elements of the innovative process can be analysed in terms of the strategic value they constitute. The three phases can be described in terms of the value they generate for the KISF:

- In the idea generation phase knowledge is created that is not (yet) dispersed, and that is highly abstract and codified. In this aspect the idea generation phase provides maximum asset growth (*maximum value creation*). This value is still latent as the knowledge resides within only a few persons.
- In the crystallization and start of the evolution phase, abstract and codified knowledge is diffused to influential actors. This phase provides value in terms of added potential for utilization of knowledge and added potential for realization of the innovation (*maximum capital creation*).

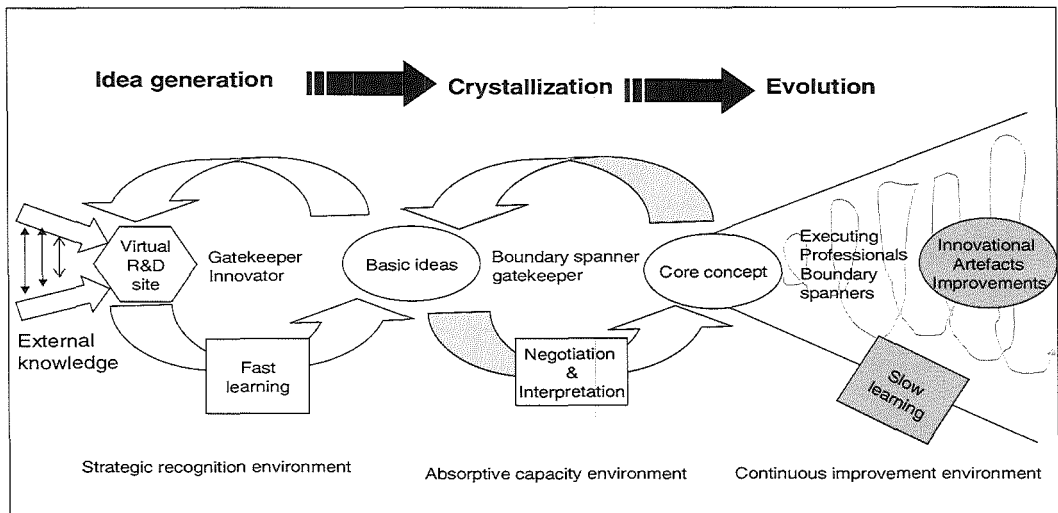
- Progress of the evolution phase leads to reduction of value as the innovation is being ‘exhausted’. The innovation is spread to a wider community, and value is withdrawn by cashing in the innovation (*value destruction*). Further exploitation of the innovation will in the long term lead to loss of strategic position (*capital destruction*).

It is a task of top management to offset a new cycle of radical innovation before value destruction transforms into capital destruction. Only by starting new innovation cycles on a regular base sustained value and capital creation can be guaranteed. The offset of a new innovation cycle will in first instance lead to (minor) capital destruction and investment as some professionals have to be isolated from the primary process in order to start a new phase of idea generation.

Learning processes in the idea generation phase are highly value adding. In line with this they can be referred to as *fast learning*. Learning processes in the evolution phase are in the longer run value destroying, but have a role (certainly in first instance) in capital creation. They are in essence less rich than learning process in the idea generation phase. As a consequence they are referred to as *slow learning*. Fast learning is based on knowledge acquisition, reflection, conceptualization, experimentation and personal knowledge building. Slow learning is based on knowledge distribution and application, continuous improvement, use of experiences and problem solving).

Final process model for radical innovations

The research project and additional discussion leads to the final process design model for radical innovations. For each phase practical design components are further elaborated into guidelines for application of the model.



SAMENVATTING

INTRODUCTIE

Het doel van dit onderzoek is het ontwerpen van een model en praktische richtlijnen voor de ontwikkeling en realisatie van radicale innovaties in de Kennis Intensieve Dienstverlening (KISFs).

Er is een groeiende noodzaak voor KISFs om kennis te creëren en, vooral, te innoveren. Het blijkt in toenemende mate moeilijk voor KISFs en kenniswerkers, om hun meerwaarde te bewijzen. Door de toegenomen beschikbaarheid van complexe kennis zijn niet alleen de mondiale concurrentieverhoudingen tussen KISFs verscherpt, maar is ook de kenniskloof tussen KISFs en hun klanten gereduceerd. Om meerwaarde te blijven leveren, moet de belangrijkste kerncompetentie van de kennisintensieve dienstverlening dan ook verschuiven van het vermogen om kennis te verwerven en te gebruiken, naar het vermogen om innovatieve ideeën te ontwikkelen en deze sneller dan de concurrentie toe te passen. Alleen hierdoor zijn KISFs in staat om ook in de toekomst hun concurrentiepositie te behouden.

Tot op heden bestaat er nog weinig zicht op de wijze waarop (radicale) innovaties in de kennisintensieve dienstverlening tot stand komen. Onderzoek op dit gebied vindt niet of nauwelijks plaats. Er is wel behoorlijk veel onderzoek gedaan naar innovatie in productiebedrijven, maar conclusies uit dit onderzoek kunnen, gezien het specifieke karakter van KISFs niet direct worden toegepast in deze sector. Hierdoor is er een gebrekkig zicht op een steeds belangrijker wordende kerncompetentie in een snel groeiende bedrijfstak: er is een duidelijke noodzaak om meer inzicht te krijgen in de creatie van radicale innovaties in de kennisintensieve dienstverlening.

KISFS

De bijdrage van KISFs aan de economische groei neemt snel toe. Enerzijds is er de groei van de dienstverlening, anderzijds het toenemend belang om gezien de mondiale concurrentieverhoudingen, de concurrentiepositie in de westerse wereld juist te baseren op kennisintensieve activiteiten.

Onder KISFs worden verstaan, organisaties die *‘diensten verlenen aan klanten, waarbij die diensten gebaseerd zijn op complexe en niet routinematige kennis en waar het merendeel van de arbeidskracht bestaat uit hoogopgeleide en hoog gekwalificeerde medewerkers’*.

In het primaire proces van KISFs en het karakter van kenniswerkers, ligt een aantal belemmeringen besloten die de creatie en toepassing van (radicale) innovaties in de weg staan:

- A. Nadruk op de ontwikkeling van *individueel intellectueel kapitaal*:
 - Het accent voor kennisontwikkeling en innovatie ligt bij het individu of groepen van individuen: de output van werkprocessen is vaak niet van te voren te definiëren, het creëren van innovaties is daardoor moeilijk op te leggen.

- Nieuwe kennis die instroomt is vaak beperkt doordat ze komt uit individuele klantencontacten gebaseerd op vigerende dienstverleningsprocessen, kennis blijft hierdoor vaak ‘binnen de grenzen’ van het bestaande (monodisciplinair en binnen bestaande technologieën).
- Kenniswerkers zijn vaak wantrouwend ten opzichte van nieuwe, onbekende inzichten en technologieën, omdat ze sterk bouwen op de eigen hoogwaardige kennisbasis.

B. Belemmeringen voor het ontwikkelen van *collectief, radicaal intellectueel kapitaal*:

- Transfer van nieuwe kennis naar de organisatie is moeilijk, omdat ontwikkeling van deze kennis bij de klant gebeurt.
- (Collectieve) radicale innovatie krijgt weinig aandacht, omdat de dominante vorm van innovatie incrementeel is: innovaties bestaan met name uit (beperkte) verbeteringen in het primaire proces.
- De grote invloed van dominante coalities van kenniswerkers op besluitvormingsprocessen in de organisatie, belemmert de introductie van nieuwe technologieën en inzichten. Deze dominante coalities hebben geen baat bij de realisatie van radicale innovaties omdat hiermee potentieel hun controle over het primaire proces, en daarmee hun machtspositie, vermindert.

Als gevolg hiervan is de kennisintensieve dienstverlening vaak veel minder innovatief dan in potentie mogelijk is. Hierdoor worden concurrentieverhoudingen nodeloos op achterstand gebracht.

Radicale innovatie

In innovatieprocessen gaat veel aandacht uit naar de mate van nieuwheid van een product. In de kennisintensieve dienstverlening is vaak niet te achterhalen hoe ‘nieuw’ een innovatie werkelijk is, maar ‘absolute nieuwheid’ heeft ook slechts een beperkte relevantie voor innovatie in KISFs. Belangrijker dan de mate van nieuwheid is de mate waarin een innovatie nieuwe toegevoegde waarde levert voor klanten en anderen, en daarmee bijdraagt aan de verbetering van de concurrentiepositie. In de praktijk bestaan succesvolle radicale innovaties in KISFs vaak uit nieuwe combinaties van bestaande concepten of toepassingen van bestaande concepten in (fundamenteel) nieuwe markten. Radicale innovaties definiëren we als ‘*innovaties die gebaseerd zijn op een fundamentele wijziging in onderliggende concepten of technologie en die leiden tot een verbetering van de strategische positie van de organisatie*’.

Het onderzoek is dan ook niet gericht op het creëren en toepassen van nieuwe diensten, maar op het creëren en toepassen van ‘fundamentele wijzigingen in concepten en/of technologieën die leiden tot reële verbetering van de concurrentiepositie’.

Onderzoeksvraag

Het doel van de studie is de ontwikkeling van een prescriptief model en gevalideerde aanwijzingen voor het ontwerpen en toepassen van radicale innovaties. Hiervoor staan de volgende onderzoeksvragen centraal:

1. Wat zijn de processen die leiden tot de creatie van radicale innovaties in KISFs?

2. Wat zijn de karakteristieken van de verschillende fasen in the creatie van deze innovaties?
3. Wat is de rol van het management en welke zijn de condities in de organisatie die de creatie van radicale innovaties faciliteren?
4. Kan het proces van creatie van radicale innovaties positief worden beïnvloed door een adequate toepassing van het proces ontwerp model voor radicale innovaties?

Methodologie

Het onderzoek is verdeeld in een descriptief deel (1) en een prescriptief deel (2):

Deel 1:

- Ontwikkelen conceptueel raamwerk op basis literatuurstudie
- Casestudie: succesvolle en niet succesvolle radicale innovatie
- Bijstelling conceptueel raamwerk en opzet model I
- Casestudie: succesvolle en niet succesvolle radicale innovatie
- Bijstelling en opzet model II

Deel 2:

- Opzet procesontwerpmodel en richtlijnen (op basis deel 1 en aanvullende literatuurstudie)
- Case: toepassing procesontwerpmodel
- Definitief procesontwerpmodel en ontwerp definitieve heuristieken

Conceptueel raamwerk

A. Innovatie management

Er is een aantal overeenkomsten en verschillen tussen innovatieprocessen in productiebedrijven en in KISFs. Een groot verschil ligt in het ontbreken van separate R&D-afdelingen in KISFs, en het feit dat in de regel in KISFs uitvoerende professionals een centrale rol hebben in innovatie. Mede op basis van deze verschillen is lang het dominante paradigma geweest dat innovatie in KISFs een optelsom is van incrementele innovaties die plaats vinden tijdens dienstverlening aan de klant. Inzichten uit de literatuur leiden echter tot de stelling dat aan incrementele en radicale innovaties twee fundamenteel verschillende processen ten grondslag liggen. Dit betekent dat radicale innovaties in KISFs niet kunnen bestaan uit een optelsom van incrementele innovaties, maar tot stand komen op basis van meer 'reflectieve en abstracte R&D-processen'. Door het ontbreken van separate R&D-afdelingen moeten deze echter buiten een klassieke R&D-setting tot stand komen.

B. Kennismanagement

Veel van de 'klassieke literatuur' over kennis en kennismanagement is gericht op gebruik en hergebruik van kennis en de efficiency in dit proces ('stock'- en 'flow'-strategieën). Kennisontwikkeling is daarbij beperkt tot ontwikkeling binnen bestaande kaders. Voor radicale innovaties is er veel meer behoefte aan inzicht in 'groeistrategieën' gericht op het proces van kenniscreatie dat plaats vindt buiten de bestaande kaders en een expliciete focus heeft op de verwerving van nieuwe kennis. Daarbij ligt het accent vooral op reflectieve en conceptuele kennisontwikkeling (embrained knowledge) en minder op ontwikkeling van actie-georiënteerde kennis en het bereiken van gedeelde betekenis (embodied en encultured knowledge). Bij het creëren van 'embrained knowledge' is de interactie tussen relevante externe netwerken en (interne) 'communities of practice' van belang. Als zodanig is de veronderstelling dat de creatie van radicale innovatie in

KISFs is gebaseerd op een combinatie van 'epistemologies of practice' (uitwisseling en ontwikkeling van kennis in het primaire proces) en meer expliciete informatieverwerkingsprocessen gericht op acquisitie en verwerking van externe kennis.

C. *Leren in organisaties*

Leerprocessen vormen een essentiële component van innovatieprocessen. Op basis van de literatuur zijn een aantal niveaus van leren te onderscheiden: reproductief leren, productief leren en exploratief leren. Radicale innovaties zijn geënt op exploratieve leerprocessen. Op basis van een discussie van de drie belangrijkste benaderingen van leren in organisaties ('cognitivisme', 'social construction' en 'experiential learning') is de conclusie dat social construction recht doet aan de interactieve en onderhandelingscomponent in leren die noodzakelijk is voor innovatie in KISFs, maar teveel gebaseerd is op exploitatie van bestaande kennis uit het primaire proces. Cognitivisme en zeker 'tweede orde' leren doet recht aan het benodigde niveau van conceptuele ontwikkeling maar doet te weinig recht aan de benodigde interactieve component. Experiential learning gebaseerd op zowel ervaringen in het primaire werkproces als op reflectie, processen van abstractie en experimenteren, lijkt het meest aan te sluiten bij de leerstijl gehanteerd bij innovatie. Voor de creatie van radicale innovaties is een combinatie nodig van deze 'experiential leerprocessen' met expliciete kennisacquisitie ('boundary spanning leren').

De 4 elementen uit de 'subjective leertheorie' vormen een helder raamwerk om de leerprocessen tijdens radicale innovaties verder te onderzoeken ('praktijktheorie', epistemologische visie, leerstrategie en doeloriëntatie).

D. *Sociaal politieke processen*

Radicalen innovatieprocessen worden bepaald door zowel leerprocessen gericht op het binnenhalen van 'nieuwe' technologische of methodologische paradigma's als door sociaal politieke processen. De sociaal politieke processen bepalen de mate waarin de dominante coalitie van kenniswerkers bereid zal zijn de bestaande competenties in te ruilen voor nieuwe competenties. Belemmerende factoren hiervoor zijn ondermeer de autonomie van kenniswerkers, maar ook de dreiging van verlies van controle over het primaire proces (omdat de kenniswerker in een nieuw paradigma tijdelijk incompetent zal zijn). Gatekeepers (importeurs van nieuwe paradigma's) hebben vaak een lage acceptatiegraad binnen de dominante groep professionals. De sociaal politieke processen binnen KISFs leiden tot een vigerende trend naar incrementele innovatie en het verwerpen van radicale vernieuwingen. Dit brengt echter de dreiging van lange termijn verlies van concurrentiewaarde met zich mee. Trajecten van radicale innovatie moeten dan ook gepaard gaan met een sterke aansturing en begeleiding van sociaal politieke processen in KISFs.

E. *Management en organisatie*

De rol van management is meer faciliterend dan sturend. Met een nadruk in de eerste fasen op strategische herkenning, markt oriëntatie en het aanboren van creatieve ideeën en in latere fasen op ontvankelijkheid voor en aanpassing aan de innovatie. Belangrijke condities in de organisatie voor het realiseren van radicale innovaties zijn, de mogelijkheid te participeren in externe kennisnetwerken, ruimte voor reflectie en de mogelijkheid reflectieve en metacognitieve vaardigheden te ontwikkelen.

CASES DEEL 1

Het descriptieve deel van het onderzoek betrof een 4 –tal casestudies, uitgevoerd bij twee KISFs: een universiteit (not-for-profit) en een architectuurbureau (profit). In beide organisaties zijn twee cases onderzocht die na analyse voldeden aan de criteria voor respectievelijk een succesvolle radicale innovatie en een niet succesvolle radicale innovatie. Het effect in termen van succes van de innovatie is gerelateerd aan leerprocessen, informatieverwerking, sociaal politieke processen en rol van management en organisatiecondities. De succesvolle cases lieten een consistent patroon zien op het gebied van leerprocessen, informatieverwerking en sociaal politieke processen. Dit effect was minder helder voor de rol van management en organisatiecondities. De patronen in de succesvolle cases verschilden duidelijk van de patronen in de niet-succesvolle cases.

Ontwikkeling procesontwerpmodel en heuristische richtlijnen

De resultaten van de cases leverden, samen met het theoretische raamwerk en een aanvullende literatuurstudie, de empirische basis voor het procesontwerpmodel en heuristische richtlijnen voor het ontwikkelen van radicale innovaties in KISFs.

CASE DEEL 2

Het procesontwerpmodel en de richtlijnen zijn toegepast in een vervolg case gericht op de radicale vernieuwing van een onderwijscurriculum binnen een universitaire faculteit. Focus van de innovatie was een fundamentele wijziging van een belangrijk deel van het primaire proces van de faculteit. De onderzoeker uit deel 1 trad op als project- en procesmanager en paste tijdens het innovatieproces het ontwerpmodel en de richtlijnen toe (een aantal richtlijnen werd direct toegepast, een aantal richtlijnen werd slechts in tweede instantie toegepast). Het effect van de toepassing van de richtlijnen was conform de verwachting: toepassing van de richtlijnen leidt tot succesvolle radicale innovatie in KISFs. Daarbij is aangegeven, dat, hoewel de innovatie als radicaal wordt beschouwd, meer solide bewijs voor de mate van radicaliteit de komende jaren nog nodig is. Ten behoeve van de objectiviteit is dit deel van het onderzoek uitgevoerd door een tweede onderzoeker.

SAMENVATTING VAN DE RESULTATEN

Voor zover de beperkingen van het onderzoek het toestaan, kunnen de onderzoeksvragen als volgt beantwoord worden:

Vraag 1: *Wat zijn de processen die leiden tot de creatie van radicale innovaties in KISFs?*

Het proces van radicale innovaties in KISFs is te onderscheiden in drie fasen: (1) idee generatie, (2) kristallisatie en (3) evolutie. Deze fasen zijn vernoemd naar de belangrijkste karakteristieken in die fase. In de verschillende fasen is er een belangrijke rol voor:

- *Leerprocessen:* spelen met name een belangrijke rol in de idee generatie en evolutiefase
- *Informatieverwerking:* speelt een rol in alle drie de fasen
- *Sociaal politieke processen:* spelen een cruciale rol in de kristallisatiefase.

Naast het verschil in belang per fasen, is er ook een duidelijk verschil in de specifieke invulling van de processen per fase (zie vraag 2). Per fase spelen verschillende (groepen van) actoren een belangrijke rol bij het tot stand komen van radicale innovaties.

Vraag 2: Wat zijn de karakteristieken van de verschillende fasen in de creatie van deze innovaties?

De drie fasen zijn duidelijk te onderscheiden aan de hand van de processen zoals ze plaats vinden en de inhoudelijke en procesmatige output die dat oplevert. De fasen zijn sequentieel in karakter: de output moet adequaat gerealiseerd zijn om de volgende fase bevredigend te kunnen laten verlopen. Dit geldt met name voor de overgang tussen de kristallisatie en evolutiefase.

- *Idee generatie fase:* Output van deze fase zijn basisideeën voor het onderliggende kernconcept voor de innovatie. Essentieel in deze fase is de acquisitie van nieuwe kennis uit externe kennisnetwerken en de (tezamen met andere leden uit deze netwerken uitgevoerde) reflectie en conceptualisatie op basis van deze kennis in de context van de 'innovatieve kwestie'. Daarnaast een experimentele leerstijl in combinatie met de reflectie en interactie in het externe netwerk. De doeloriëntatie in de leerprocessen is sterk op persoonlijke kennisopbouw gericht (in plaats van op probleemoplossing). De interactie tussen de participanten in het kennisnetwerk is het best te omschrijven als een 'virtuele R&D-site'. Belangrijkste actoren in deze fase zijn 'gatekeepers', die toegang hebben tot externe netwerken (veelal voortkomend uit multi-lidmaatschap van meerdere organisaties) en deze kennis in de organisatie importeren. Vaak zijn 'gatekeepers' zelf de belangrijkste 'innovators' of werken ze samen met innovators die aan de basis staan van nieuwe ideeën. In de regels hebben gatekeepers en innovators een lage acceptatiegraad in de organisatie, behalve wanneer ze als leidinggevende of grondlegger van de organisatie een centrale rol vervullen. Andere leden uit de organisatie hebben weinig tot geen rol in deze fase.
- *Kristallisatie fase:* Output van deze fase is een 'gereïficeerd kernconcept'¹ waarover overeenstemming bestaat bij zowel gatekeepers en innovators, bij opinieleiders uit de dominante coalitie van kenniswerkers (of opinieleiders van relevante externe partijen) en bij topmanagement. Deze opinieleiders zijn te benoemen als 'boundaryspanners' die een essentiële rol spelen in het daadwerkelijk accepteren van nieuwe kennis en ideeën uit het externe netwerk, in de organisatie. Belangrijkste processen in deze fase zijn de sociaal politieke onderhandelingen tussen gatekeepers en innovators, en boundary spanners, en de informatieverwerking gericht op de collectieve interpretatie van die nieuwe kennis en ideeën door de genoemde partijen. De sociaal politieke onderhandelingen en collectieve interpretatie zijn erop gericht de basisideeën om te vormen tot een kernconcept dat functioneert als het nieuwe paradigma en referentiekader voor de KISF. De onderhandelingen tussen gatekeepers/innovators en boundary spanners zijn in de regel spanningsvol omdat de eerste partij tendeert naar verregaande ideeën en boundary spanners in de regel streven naar bevestiging van de eigen ervaringen en afstemming met bestaande visies. Effectieve boundary spanners zijn informele leiders binnen de eigen groep maar zijn tegelijkertijd vernieuwingsgezind. Top management speelt een essentiële rol in het regisseren van het politieke proces tussen boundary spanners en gatekeepers. Nadat het kernconcept is gecreëerd en er overeenstemming over is bereikt, start een nieuw (sociaal politiek) proces.

¹ Gereïficeerd kernconcept: een abstract concept dat beschouwd wordt als daadwerkelijk bestaand of als een concreet materieel object

De boundary spanners sturen de overige kenniswerkers in de organisatie aan op reïnterpretatie van de ervaringen en competenties in het primaire proces in de context van het nieuwe referentiekader. Het is essentieel dat het kernconcept aan een aantal eisen voldoet. Enerzijds voldoende eenduidig om als leidend concept vorm te geven aan het vervolproces. Anderzijds op voldoende abstractieniveau om kenniswerkers ruimte te bieden om binnen het nieuwe referentiekader zelf de vernieuwingen vorm te geven en voldoende generaliseerbaar naar meerdere situaties te zijn. Uit het onderzoek blijkt dat te sterk prescriptieve kernconcepten of juist 'pseudo kernconcepten' waar geen eenduidigheid en overeenstemming over bestaat, fnuikend zijn voor de daadwerkelijke realisatie van radicale innovaties.

- *Evolutiefase:* Output van deze fase is een continue stroom van innovaties (diensten, visies, kennis), verbeteringen en 'reïnnovaties' die passen binnen het kernconcept. In deze fase ontstaat een proces van incrementele innovatie op basis van het meer radicale voortraject dat in de eerste twee fasen plaats vond. Het belangrijkste proces in deze fase is informatieverwerking gericht op continue verbetering en incrementele innovatie binnen het nieuwe referentiekader (paradigma). De informatieverwerking is gericht op distributie van het kernconcept, distributie van nieuwe inzichten door het herinterpreteren van kennis en kerncompetenties in het nieuwe referentiekader, en toepassing van deze kennis en inzichten ter realisatie van de daadwerkelijke innovaties. Informatieverwerking vindt plaats in combinatie met leerprocessen. De leerprocessen focussen op continue verbetering en verwerken van eigen ervaringen uit het primaire proces. De doeloriëntatie is gericht op probleemoplossing en taakrealisatie. Belangrijke actoren in deze fase zijn boundary spanners die functioneren als ambassadeurs van het nieuwe kernconcept en referentiekader. Zij zijn tevens degenen die de realisatie van innovaties toetsen aan het nieuwe paradigma om terugvallen in de oude groef te voorkomen. Hun rol als 'early adopters' en opinieliders is essentieel voor de acceptatie van kernconcept en referentiekader door de dominante coalitie van kenniswerkers in de KISF (dan wel de relevante buitenwereld). Daarnaast spelen de uitvoerende kenniswerkers die de uiteindelijke innovaties in hun primaire proces realiseren en werken aan acceptatie bij klanten een hoofdrol.

Vraag 3: *Wat is de rol van het management en welke zijn de condities in de organisatie die de creatie*

van radicale innovaties faciliteren?

Dit onderwerp is niet rechtstreeks geadresseerd in het onderzoek. Uit het onderzoek is echter te deduceren dat er een duidelijke en belangrijke rol is voor het management en de condities in de organisatie. Deze rol verschilt per fase:

- *Idee generatie fase:* Voor management is de rol in deze fase te typeren als 'strategische herkenning'. Strategische herkenning betreft:
 - herkennen van de noodzaak tot radicale innovatie en als gevolg daarvan het vrijwaren van gatekeepers en innovators van de druk om directe opbrengsten te genereren: het balanceren tussen de noodzaak van waardecreatie op lange termijn en de acceptatie van kapitaalvernietiging op korte termijn.
 - het vermogen om die gatekeepers en innovators en externe netwerken te herkennen die in staat zijn om op langere termijn waardevolle ideeën voor radicale innovaties te genereren dan wel het zelf mede creëren van deze netwerken: de selectie en creatie van waardevolle virtuele R&D-sites.

- het vermogen om ideeën te selecteren voor verdere ontwikkeling die waarde creëren en die verrijkend zijn voor de reeds beschikbare competenties: selectie van keuzen leidend tot kapitaalverrijking in plaats van majeure kapitaalvernietiging.
 - Daarnaast zal het management actief moeten zijn in het scheppen van condities voor goed functionerende R&D-sites:
 - het in staat stellen van (potentiële) gatekeepers en innovators om externe netwerken te creëren of in bestaande netwerken te participeren.
 - het creëren van condities die leiden tot reflectie, conceptualisering, experiment en de ruimte voor persoonlijke kennisopbouw in plaats van probleemoplossend gedrag.
- *Kristallisatiefase:* Voor het management is deze fase te typeren als ‘vergroten van absorptiecapaciteit’. In deze fase speelt met name het topmanagement een rol. Het accent ligt op het identificeren van die boundaryspanners die kunnen omgaan met de tegenstrijdigheden van radicale vernieuwing en de neiging tot behoud van bestaande patronen en werkprocessen van de dominante coalitie. Topmanagement speelt een regierol bij de politieke onderhandelingen en collectieve interpretatie van gatekeepers/innovators en boundary spanners. Daarbij is er een sturende rol in termen van bewaking van de mate van radicaliteit van de innovatie. Management speelt een sturende rol in de ontwikkeling van radicale innovaties die kapitaalverrijkend in plaats van kapitaalvernietigend zijn. Inherent hieraan is de keuze van management voor incorporatie van de innovatie in de eigen KISF (bij kapitaalverrijking) dan wel onderbrenging in een spin off.
 - *Evolutiefase:* de focus in de rol van het management en de organisatiecondities liggen hier op het creëren van leeromgevingen voor de gemeenschap van kenniswerkers, waar incrementele innovatie en continue verbetering plaats kan vinden. Zowel structuur als cultuur dient gericht te zijn op experimenteren en leren op kleine schaal. Daarnaast heeft management een toetsende rol om te bepalen dat het primaire proces daadwerkelijk conform de nieuwe referentiekaders verloopt.

Vraag 4: *Kan het proces van creatie van radicale innovaties positief worden beïnvloed door een adequate toepassing van het proces ontwerp model voor radicale innovaties?*

Uit het onderzoek blijkt dat toepassing van de richtlijnen leiden tot meer succesvolle innovaties dan in de niet succesvolle cases. Adequate toepassing van het model draagt dus bij aan de creatie van radicale innovaties. Daarbij dient uitdrukkelijk te worden gesteld dat de richtlijnen uit het model heuristisch zijn en niet algoritmisch. Er kan dus geen sprake zijn van letterlijke toepassing. Aanpassing van de richtlijnen aan de betreffende situatie is nodig afhankelijk van overeenkomsten en verschillen met de case uit deel twee van dit onderzoek.

Relevantie voor andere organisaties

Er zijn een drietal belangrijke verschillen tussen innovatieprocessen in productiebedrijven en in KISF. In productiebedrijven vindt de start voor innovaties (ontwikkelen van prototypes) in de regel plaats in R&D-afdelingen. In KISFs vindt dit plaats in virtuele R&D-sites gevormd door enkele leden uit de eigen organisatie die participeren in externe kennisnetwerken. In KISFs is er een veel sterkere invloed van sociaal politieke processen dan in productiebedrijven, op het succes van het innovatieproces. In tegenstelling tot productiebedrijven vindt in KISFs de daadwerkelijke realisatie van de innovatie plaats tijdens het primaire proces door de uitvoerende gemeenschap van kenniswerkers zelf. Deze hebben een belangrijke rol bij de vormgeving van de

uiteindelijke innovatie zoals die aan de klant geleverd wordt. Het onderliggende kernconcept moet op een voldoende abstractieniveau zijn gedefinieerd om ruimte te geven voor uitwerking van de innovatie door de kenniswerkers. Dit in tegenstelling tot prototypes in productiebedrijven die vaak veel meer gespecificeerd zijn.

Het onderhavige onderzoek is ook relevant voor op andere (onderdelen van) organisaties waar kenniswerkers het belangrijkste deel van het medewerkersbestand vormen.

Radicale innovaties en verandermanagement

Het radicale innovatieproces heeft een grote overeenkomst met meer algemene grootschalige veranderingsprocessen. Op basis van een vergelijking van het kleurenmodel voor verandering van De Caluwé en Vermaak zijn de drie fasen van radicale innovatie te karakteriseren in termen van een dominante kleur. De idee generatiefase is voornamelijk wit met een nadruk op zelfgestuurde en autonome verandering die dynamisch is, verankerd in experiment en dialoog en metaparadigmatisch. De kristallisatiefase is vooral geel, gericht op de sociaal politieke processen in de organisatie. De evolutiefase is hoofdzakelijk groen, gericht op collectief leren en leerprocessen.

Radicale innovaties en kenniseconomie

Op basis van de gegeven definitie van radicale innovaties en de bijdrage van innovaties aan de strategische positie van de organisatie, is ook een analyse mogelijk van het procesontwerpmodel in termen van strategische waarde. De drie fasen van het innovatieproces zijn te relateren aan de waarde die ze voor de organisatie genereren:

- De idee generatiefase levert kennis op die (nog) niet verspreid is, hoog abstract en gecodificeerd in karakter. Daarmee biedt deze fase een maximale toegevoegde waarde in kennis (*maximum value creation*). Het gaat dan nog om waarde in potentie, omdat de kennis nog in geïsoleerde personen aanwezig is.
- De kristallisatiefase levert abstracte, gecodificeerde kennis op, die verspreid is over de in dit kader meest invloedrijke groep van personen. Deze fase levert vooral waarde in termen van toegevoegde potentie van benutting (*maximum capital creation*), omdat kansen op realisatie sterk verhoogd zijn.
- Voortgang van de evolutiefase levert in feite waardevermindering op, omdat de innovatie uitgeput wordt. Er wordt waarde onttrokken door verzilvering van de innovatie en toevoeging aan het kapitaal van de organisatie (*minimal value creation of value destruction*). Steeds verdere uitontwikkeling van de innovatie levert op de lange termijn verlies aan kapitaal op (*capital destruction*).

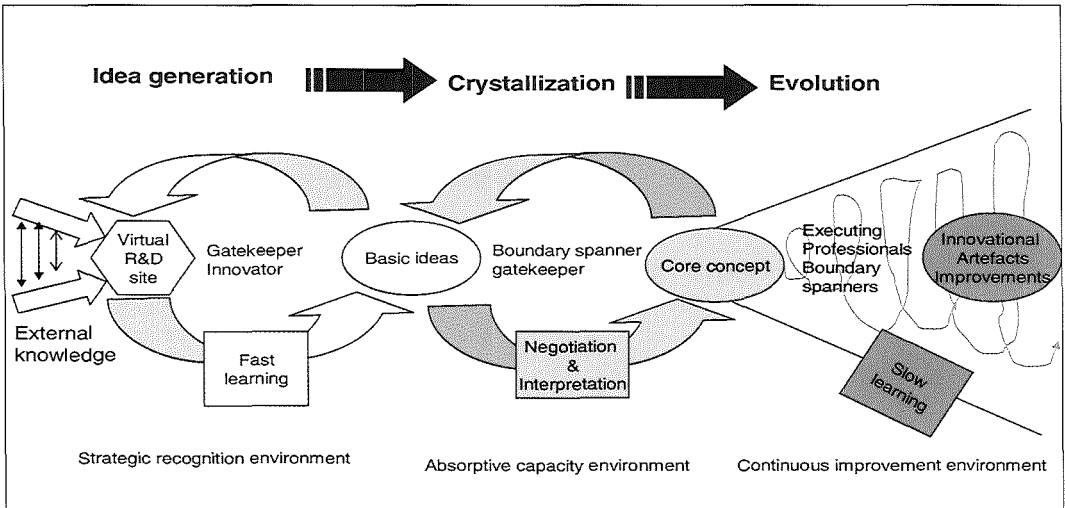
Voordat in de evolutiefase waardevernietiging dreigt over te gaan in kapitaalvernietiging, is het zake nieuwe radicale innovatiecycli te starten om ook voor de langere termijn waarde- en kapitaalcreatie te blijven realiseren. Dit leidt in eerste instantie tot kapitaalvernietiging, omdat in termen van medewerkers en processen ruimte nodig is voor nieuwe processen van innovatie.

Leerprocessen in de idee generatiefase zijn sterk waarde toevoegend, ze zijn als '*fast learning*' te beschouwen (fast learning gebaseerd op kennisacquisitie, reflectie, conceptvorming, experimenteren en persoonlijke kenniscreatie). Omdat de leerprocessen in de evolutiefase weliswaar kapitaal toevoegen, maar geen waarde toevoegen, zijn ze als '*slow learning*' te beschouwen

(slow learning gebaseerd op kennisdistributie en –toepassing, ervaringsleren, continue verbetering en probleemoplossend).

Definitief procesontwerpmodel voor radicale innovaties

Op basis van het onderzoek is een procesontwerpmodel voor radicale innovaties ontwikkeld. Per fase zijn de ontwerprichtlijnen verder uitgewerkt en is een onderbouwing van de uitwerking gegeven.



ABOUT THE AUTHOR

Anna Bernadette Marie van Poucke was born on August 13th 1960, in Hengelo (O) (the Netherlands). She obtained a Master degree in Psychology from University Brabant in 1987. In addition she studied Management Sciences at University College Cardiff, where she obtained a Master of Philosophy degree in 1990. After graduation from the University Brabant she worked as a (senior) management consultant and product manager for GITP management consultants. She specialized in strategic and HRM-consulting in knowledge-intensive service firms. In 1995 she became head of the management consultancy division of the University Hospital in Utrecht. In April 1998 she started a Ph.D. project at the faculty of Economic Sciences, Erasmus University Rotterdam. This Ph.D. project has resulted in the present dissertation. She combined her Ph.D project with her own consultancy and interim management firm. In recent years her projects concerned consultancy and interim management in hospital mergers, consultancy and project management of academic curriculum innovation, consultancy and interim management in strategic renewal in different knowledge intensive settings, and coaching of managers and management teams in professional service firms.

She was author and co-author of several publications, amongst which the book in the SMS-series 'Besturing van professional organisaties: van praktijk naar onderneming' [Governance of professional service firms].