# AUTOPOIETIC ORGANISATION OF KNOWLEDGE, CREATIVITY AND INNOVATION

A case study of the automotive manufacturer Daimler AG

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## *Abstract*

This doctoral thesis presents an analysis of the context in which creativity and innovation emerges. It is based on an investigation of a single case organisation.

The theoretical framework for the study derived from a number of fields, including organisational studies, social science and systems theory. Of particular importance were studies of organisational systems, their function, and the dynamics that allow creativity and innovation to emerge. Autopoietic system theory is relevant here.

The empirical work was conducted in a single large case study organisation based in Germany. Daimler AG, served as the site of data collection. The data for analysis was generated from a survey, focus groups and interviews.

The study identified large organisational structures such as organisational design, culture and information and knowledge, which constrain or enable the fluid process of routines, individuals' interactions, and knowledge and idea creation. These structures are highly interrelated and correlate with the organisational innovation performance. These structures turn into fluid patterns of individual and group creativity. Nine patterns were identified, which build a pattern language of creativity in organisations. This pattern language consists of three main "pattern rules".

The contribution of the study is the identification of three main factors or "pattern rules" that underpin creativity and innovation. These are (1) diverse experienced experts within the "thick of the action"; (2) innovation willingness to create and support change; (3) "free space" where employees can explore, create and prototype new ideas. In this thesis this concept is labelled "Freiraum", which is the German word for "free space" in which individuals and teams can achieve their potential. These rules build a model of two spaces, which facilitate a spiral of creativity driven by the innovation willingness. This model provides explanation of how creativity and innovation emerges within the context of an organisation. This work draws particular attention to the dynamics of creativity and innovation, and the influence of organisational control on redundancy of the system, where high control leads to low redundancy and vice versa.



**Keywords:** Creativity, Innovation, Organisational knowledge creation, Autopoietic System theory, Pattern language

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Creativity is a network of many different sparks from the beginning of a lifetime to its end and so is a research project. Therefore, I thank every single employees of the over three hundred participant at Daimler AG for sharing their valuable experience and insights and providing these valuable sparks. Without you, this research would have not been possible. Furthermore, I would like to thank the many persons, who supported me throughout my work at Daimler AG (DaimlerChrysler AG). Unfortunately, I cannot name them all. To name a view, I would like to thank Matthias Mayer, Ralf Mesenbrock, Werner Schaner, and Ruud Weiss.

I thank my family, friends and everybody who walked alongside with me during this time, you know who you are. Thank you!


## *Declaration*

This thesis is entirely my own original piece of work, based on data that I gathered and analysed. All extracts and non-original work have been appropriately attributed and cited.

## *Dedication*

***to Siggi, Jörg and Dirk and to the memories of Rose***

***for supporting every idea I've decided to pursue.***

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## Glossary

| | |
|---|---|
| Autopoiesis | An autopoietic machine [system] is a machine [system] organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network." (Maturana & Varela, 1980, pp. 78-79) |
| Bewohner | is the German word for inhabitant. In the context of a large organisation in Germany, 'Bewohner' are categorised as satisfied but unmotivated. |
| Freiraum | Freiraum (Freiräume, plural) is the German word for 'free space', 'free room' or 'free field', which can have a mental, social and physical, virtual and regulatory characteristics. According to the German dictionary Duden, Freiraum is the "opportunity to develop one's own strength and ideas (of a person or a group)" [in German: "Möglichkeit zur Entfaltung eigener Kräfte und Ideen (für eine Person oder Gruppe)"] ("Freiraum, der," 2012) |
| Miteinander | can be translated as 'together' and 'with each other', which can be seen as individuals work jointly as a unity. |
| Mitnehmen | means to include and inform someone and to convince someone to support an idea. |
| Ort | 'Ort' is the German word for 'place'. Ort on Heidegger's account is the translation of the Greek term 'topos' (spatial extension of entities) (Malpas, 2006). |
| vor Ort | means being at the place of the event or incidence ('Ereignis'). |

# Chapter 1 Introduction

*"Die Luft der Freiheit weht."*

*Ulrich von Hutten* cited in Casper (1995)

***Keywords***

Introducing the topic · The study · Research questions · Overview of chapters ·

## 1.1 Introducing the topic

This research examines the context of a single case organisation in which creativity and innovation emerges. A large German case organisation, Daimler AG serves as the site for data collection. The study investigates the organisation of knowledge, creativity and innovation. The theme of the organisation of knowledge, creativity and innovation deals with how the organisation as a system facilitates creativity and innovation. The term 'organisation' has three main implications for an investigation of creativity and innovation. First, it suggests that 'the organisation' as an entity includes an organisational innovation capability, which facilitates creativity and innovation. Second, the verb 'organising' implies action, interaction and practices, which produce new ideas and develop them into innovation. This is dynamic and emergent in nature. Third, the complexity of creativity and innovation incorporates both 'the organisation' as entity and 'organising' as fluid process. 'The organisation' as a capability and the 'organising' as a fluid process of action and interactions of individuals are recursive interacting. The structure of 'the organisation' turns into the fluid process and in turn the fluid process produces the structure (Bakken & Hernes, 2006; Hernes, 2004a). Within this recursive interaction or self-reproduction creativity and innovation emerge as a function of redundancy (Bakken, Hernes, & Wiik, 2009a). The research will investigate the recursive interaction between 'the organisation' and 'organising' in relation to knowledge creation, creativity and innovation.

### 1.1.1 *Organisational innovation capability*

The organisation innovation capability ('the organisation') incorporates the structure of the organisation including its organisational design, culture, infrastructure and networks. Organisations face the challenge of developing organisational structures to either exploit or explore innovation (Christensen, 1997; O'Reilly & Tushman, 2007). The innovator's dilemma can be solved by building an 'ambidextrous organization' (O'Reilly & Tushman, 2004; Tushman & O'Reilly, 2006). Furthermore, organisational design, behaviour and knowledge resources need to facilitate creativity within the organisation to produce innovation (for example Andriopoulos, 2001; Andriopoulos & Dawson, 2009; Woodman, Sawyer, & Griffin, 1993; Zhou &

Shalley, 2008). This requires dynamic capabilities rather than static capabilities (Teece, 2009). Gilson, Mathieu, Shalley, & Ruddy (2005) and Kondo (1995, 2000), also argue that creativity cannot be established through standardised structures, practices, actions and processes. Instead, creativity requires patterns or 'ways of doing things', a 'creative kata' as stated by Nonaka & Toyama (2007, p. 25). Similarly, Iba (2010) also emphasised using patterns to identify actions and interactions that facilitate creative discoveries. This leads to the 'organising', the fluid process of action, interaction and practices.

### 1.1.2 *Organising and creativity as fluid process*

'Organising' the fluid process in which new ideas and solutions are created and developed into innovation includes patterns of action and interactions of individuals and teams that underpin creativity. This includes (1) individual creativity, (2) group creativity and (3) processes of creativity. Individual creativity includes several cognitive or mental factors, which are influenced by the environment of an organisation (for example Amabile, 1996a; Amabile & Kramer, 2011; Csíkszentmihályi, 1996; Perry-Smith, 2006; Woodman, et al., 1993). Similarly, group creativity includes social interactions and group compositions (for example Milliken & Martins, 1996; Paulus & Nijstad, 2003; Sawyer, 2007; Taggar, 2002). These several influencing factors of actions and interactions build patterns, which can facilitate or prevent creativity. These actions and interactions of momentary events are bound in space-time and build distinct spaces. Different established and configured spaces can facilitate knowledge creation, creativity and innovation (for example Amin & Roberts, 2008a; Crang & Thrift, 2000; Nonaka & Konno, 1998; Thrift, 2006). Different spaces offer a promising approach to overcome the 'ambidextrous organization' as stated by Delemarle & Larèdo (2008) and build dynamic organisational capabilities. Nonaka, Toyama, & Hirata (2008) provide several case studies such as Honda Motor Co., Ltd., Toyota Motor Company and Mayekawa Manufacturing Co., Ltd., which use different configured spaces ('Ba') to create new knowledge and produce innovation.

### 1.1.3 *Organisation of knowledge, creativity and innovation*

In this research the word 'organisation' refers to both 'the organisation' as an entity (macro level) and 'organising' as a fluid process (micro level). The multiple-level complexity of the organisational capability ('the organisation') and group dynamics and individual skills ('organising') needs to be taken into account to elaborate a theory of creativity and innovation in organisations as advocated by Amabile & Mueller (2008, p. 34). Similarly, Csíkszentmihályi (1999) argues that creativity emerges within the interaction of the system ('the organisation') and individuals ('organising').

To provide a new perspective of the organisation of knowledge, creativity and innovation, the research in this thesis discussed the recursive interaction between 'the organisation' as an entity and 'organising' as a fluid process or flow in relation to knowledge, creativity and innovation. This recursive interaction is an autopoietic system.

## 1.2 The study

The study investigates a nascent field of research, which becomes significantly more relevant in the near future. The director of 3M Germany, Jürgen Jaworski argues that the age of the innovation culture just begins as customer requirements, fluctuation of loyalty and competition increase, while product and service life-cycle fasten (Jaworski & Zurlino, 2009, pp. 11-13). There are specific considerations to be made to investigate the autopoietic system of the organisation of knowledge, creativity and innovation.

### 1.2.1 *An automotive manufacturer, Daimler AG as context*

With any research there is a choice to be made in terms of the sample, context or site. This research identified the Daimler AG as a suitable site for studying the organisation of knowledge, creativity and innovation. This company is one of the leading automotive manufacturers with a long history in innovation ("125 years of innovation," 2010). The selection of the study and site is the result of two considerations. Firstly, the researcher's personal interest in the domain of creativity and innovation in organisations and its increasing importance led to the topic of this study. Secondly, the researcher's past work experience at the DaimlerChrysler (now Daimler AG and Chrysler Group LLC) at the headquarters in Stuttgart, Germany and internationally led to studying the topic in the field of the automotive industry. This work experience allowed observing the ever increasing importance of innovation in organisations and the motivation to investigate the field.

This in-depth case study allowed an investigation into the context of a large, global organisation. Furthermore, the recent increasing innovation spirit in the automotive manufacturer industry in recent years makes the automotive industry an interesting context and site to study the organisation of knowledge, creativity and innovation. In particular Daimler AG is an interesting case for studying innovation as they are at the forefront in fields such as alternative drive-systems, safety-systems and new urban mobility concepts such as Car2Go.

### 1.2.2 *Research question, objectives and approach*

The research set out to answer the question,

> "what are the main factors and how do they underpin creativity and innovation in a large, global manufacturing company[1]?"

The question presents three main research objectives; (1) the investigation of the organisational context ('the organisation') in relation to innovation; (2) the examination of the context in motion of the fluid process of action and interactions of individuals in relation to creativity ('organising'). (3) The examination of the recursive interactions (self-reproduction) between the organisational context ('the organisation') and fluid process of action and interactions of individuals ('organising') in relation to creativity and innovation.

For this investigation, the research adopted autopoietic system theory to investigate the recursive interaction of 'the organisation' and 'organising'. Several scholars

[1] In this case Daimler AG

discuss the autopoiesis in organisation (for example Bakken & Hernes, 2003a; Hernes, 2004a; Hernes & Bakken, 2003; Luhmann, 2000; Magalhães & Sanchez, 2009a). Autopoietic system theory is combined with the approach of space as discussed by Hernes (2003, 2004a, 2004b). This permitted the investigation of the three research objectives to answer the research question.

Firstly, the study investigated 'the organisation' as an entity in relation to creativity and innovation. Researcher's concern is that 'the organisation' incorporates greater mental spaces such as thought collective, greater social spaces such as social network and shared behaviour and greater physical, virtual and regulatory spaces such as organisational design as discussed by Hernes (2004a). These spaces and their inherent mechanisms and dynamics are investigated in relation to the innovation performance to examine the organisational innovation capability. This investigation was executed through a survey study to access employees' perception of their work context and innovation performance. This method is a widely used approach in the studies of organisational creativity (Shalley & Zhou, 2008, pp. 18-20). The innovation performance measure is correlated with the organisational context to examine the organisational innovation capability. This built a 'hard' system model of the organisational innovation capability ('the organisation').

Secondly, the 'organising' of the fluid process of individuals' interactions in relation to creativity and innovation was examined as part of this study to identify the context that produces the spaces that facilitate creativity within the fluid process. As 'the organisation' (greater space) constrains or enables the context of individuals' interactions ('organising'), the results of the survey study ('the organisation') were presented in focus groups and discussed in relation to the actions and interactions of individuals ('organising'). This allowed an examination of the recursive interaction (self-reproduction). Furthermore, interviews were conducted to examine the fluid process of individuals' interactions in which creativity emerges. The context of the fluid process in which creative discoveries are made in the company were examined through design patterns as recommended by Iba (2010). The identified patterns produced a pattern language of creativity. The approach of the pattern language[2] comes from the field of architecture and was developed by Alexander, Ishikawa, &

[2] Pattern language will be discussed on page 106 and page 155

Silverstein (1977). The pattern language revealed "pattern rules" and dynamics that produce spaces in which creativity and innovation emerge in the company. This built a 'soft' system model of the process of creativity ('organising').

Thirdly, the integration of the 'hard' and 'soft' system model permitted the examination of the recursive interaction of 'the organisation' and 'organising'. This allowed the elaboration of the theoretical framework of the autopoietic system of the organisation of knowledge, creativity and innovation.

### 1.2.3 *Main contribution of the empirical work*

The contribution of the study is that three "rules" that underpin creativity and innovation are (1) diverse experts with experience, (2) innovation willingness to create and support change and (3) *Freiraum*. This further extends existing theory on organisational knowledge creation and creativity and innovation theory. It draws particular attention to dynamics of creativity and innovation and the influence of organisational control on redundancy of the system, where high control leads to low redundancy and vice versa. This elaborated dynamic framework enables contextual ambidexterity through the production of different spaces in which the organisation facilitates both exploitation and exploration of innovation.

## 1.3 Overview of chapters

Chapter 2 discusses the existing theory of creativity and innovation and organisational knowledge theory. This chapter is divided in four main parts. Firstly, the different definitions and perspective of creativity and innovation are examined. Secondly, the organisational knowledge theory is discussed. This discussion leads into the third part of individual and group creativity and organisational innovation. The chapter ends with the discussion of rethinking organisational research from an 'absolute view' ('the organisation' as entity) and a 'process view' ('organising' as fluid process) to a third view, the 'self-producing view'. This incorporates the recursive interaction between 'the organisation' ('absolute view') and 'organising' ('process view') based on the account of Whitehead (1978) (Bakken & Hernes, 2006).

Chapter 3 follows up the 'self-producing view', which is based on the theory of autopoiesis. This chapter describes autopoietic system theory. Its coverage includes autopoiesis and cognition, social autopoiesis and autopoietic organisational theory. In this chapter the autopoietic system, its characteristics and functions are explained. Furthermore, the several autopoietic systems are discussed: (1) autopoiesis and cognition (Maturana & Varela, 1980, 1992) and its implications for knowledge creation. (2) social autopoiesis to include theories such as structuration (Giddens, 1984), social autopoiesis (Luhmann, 1995) and critical social autopoiesis theory (Fuchs, 2003, 2004). This is followed by the discussion of the autopoietic organisation theory (for example Bakken & Hernes, 2003a; Hernes, 2004a; Magalhães & Sanchez, 2009a). There then follows a discussion of space as a dynamic and boundary of autopoietic systems, as argued by Hernes (2003, 2004a, 2004b). After this the theory of change as relevant to system theory is exposed. This consideration of the topic is based on the panarchy model by Gunderson & Holling (2002). The model describes change in natural and social systems such as economies, societies and organisations. Chapter 3 concludes with a discussion of the autopoietic system in relation to the organisation of knowledge, creativity and innovation.

Chapter 4 evaluates the methodology adopted for the main empirical study. An in-depth case study approach was adopted, in which contextual data was gathered by survey, focus groups and interviews over a period of fourteen month from November 2007 to December 2008. The survey data was analysed to reveal the 'hard' system model of 'the organisation' as an entity. The focus group data, including the survey findings, and the interview data were analysed to model the 'soft' system model of the fluid process of creativity ('organising') through a pattern language.

Chapter 5 presents the findings from the survey data and gives an analysis of the organisational context ('the organisation'). Modelling the 'hard' system model through a confirmatory factor analysis (CFA) and Pearson's correlation analysis (PCA) gives a picture of employees' perception of the work context. The analysis revealed the dynamics and complexity of 'the organisation' in relation to its innovation performance.

Chapter 6 presents an analysis of focus group and interview data. This analysis reveals the context of individuals' interactions that build a fluid process of creativity. The analysis derived from a pattern analysis and the generation of a pattern language. The pattern language exposed three "pattern rules" of creativity in an organisation: (1) diverse experts with experience, (2) innovation willingness to create and support change and (3) *Freiraum*. These "pattern rules" build the 'soft' system model of the context of the fluid process of creativity ('organising').

Chapter 7 discusses the findings of the empirical work. It is divided in three sections. Firstly, the organisation of knowledge, creativity and innovation within the self-reproduction of the organisation is discussed in relation to existing theories and studies. This recursive interaction between 'the organisation' and 'organising' reveals dynamics that can prevent or facilitate creativity and innovation. The second part of this chapter evaluates the spiral of creativity (creative process) in relation to theories of individual and group creativity. Lastly, the chapter ends by presenting the theoretical framework of the autopoietic system of the organisation of knowledge, creativity and innovation that has been modified to incorporate the findings of this study. This dynamic model provides a framework that captures the complexity and dynamics of creativity and innovation within an organisation. It offers insights of how a system needs to function to produce spaces in which creativity and innovation emerges and both exploitation and exploration of innovation is dynamically accomplished.

Finally, the concluding chapter (chapter 8) illustrates the main contribution of the research and its research implications and limitations. The chapter ends by proposing future research agendas. This may open up new ways of investigation related to the organisation of knowledge, creativity and innovation.

# Chapter 2 Organisational and management theory of knowledge, creativity and innovation

*"The desire to do something because you find it deeply satisfying and personally challenging inspires the highest levels of creativity, whether it's in the arts, sciences, or business."*

*Teresa M. Amabile* cited in Pink (2009, p. 116)


*Keywords*

Creativity and innovation · Organisational knowledge theory · Individual creativity · Group creativity · Organisational creativity ·

## 2.1 Introduction

This chapter discusses the extant literature on the organisation of knowledge, creativity and innovation. This provides an understanding of the inherent complexity of the organisation of knowledge, creativity and innovation. The chapter is organised in seven parts.

1. The chapter discusses different definitions and perspectives of creativity and innovation. It provides an overview of what creativity and innovation is. This discussion includes the definitions and perspectives of creativity as an outcome and a process, and innovation as an outcome and a process. However, there is a third approach which sees creativity and innovation as part of a system. This system perspective includes creativity as process and outcome of interacting individuals ('organising', micro level) and innovation as process and outcome of 'the organisation' (macro level). This leads to the discussion on the organisation of knowledge, creativity and innovation as a system.

2. Organisation as a system has been identified and discussed in the literature from different approaches and theories. This section of the chapter provides an overview of different approaches and the main theory of knowledge creation in relation to creativity and innovation. This discussion leads to the identification of the inherent complexity of knowledge creation, creativity and innovation in organisations.

3. The inherent complexity of organisation of knowledge, creativity and innovation is discussed. This includes the multi-levels of individual, group and organisation and the multiple factors of cognitive, social and contextual influences. These multi-levels and multiple factors are discussed in more detail to provide an overview of already identified factors and dynamics in organisation that facilitate knowledge creation, creativity and innovation.

4. This section of the chapter provides a discussion of individual creativity and the cognitive processes that lead to a creative performance.

5. In addition to individual creativity, group creativity is discussed. This section provides an overview of the dynamics within interactions of individuals that can facilitate creativity. This includes group composition, group characteristics and group processes.

6. The individual and group creativity ('organising') is determined by the organisational innovation capability ('the organisation'). Therefore, the main factors and dynamics of the organisational innovation capability are discussed.

7. These multiple levels and factors provide an holistic overview of the complexity of knowledge creation, creativity and innovation inherent in organisations. The chapter results in a conceptual framework of the organisation of knowledge, creativity and innovation.

## 2.2 What is creativity and innovation?

Creativity and innovation can be seen as the concepts in which humans create, develop and adopt change. There are several interpretations and perspectives on the concepts of creativity and innovation. This section reviews and discusses the different viewpoints of the definition of creativity and innovation. Firstly, the definition of creativity is discussed. Secondly, the definition of innovation is examined. Lastly, the section reviews a third definition, namely, the system view of creativity and innovation.

### 2.2.1 *Definition of creativity*

Many studies have investigated the concept of creativity. However, there is no unambiguous and generally accepted definition of the phenomenon or concept of creativity. Creativity has been defined as (1) an outcome or (2) a process (Shalley & Zhou, 2008). Creativity as an outcome has been defined by Amabile (1996a, p. 35) as follows:

> "A product or response will be judged as creative to the extent that (a) it is both a novel and appropriate, useful, correct or valuable response to the task at hand, and (b) the task is heuristic rather than algorithmic." (Amabile, 1996a, p. 35)

Therefore, creativity can be defined as a (1) novel and (2) valuable idea, solution, concept or response. A different view is taken by Weisberg (2006, pp. 63-72) as he defines creativity as the production of novelty regardless its value. These two different views incorporate the discussion of whether creativity incorporates social judgment as argued by Csíkszentmihályi (1999) or incorporates an intrinsic nature as discussed by Iba (2010, p. 6612). Creativity is seen in this view as an entity such as an utterance or response of a novel and valuable (appropriate, useful, repeatable, feasible or, viable) idea or solution.

There are also scholars who define creativity as a process. For instance, Lubart (2001) stated the creative process as to be the sequence of thoughts and actions that leads to a novel, adaptive production. An early attempt of creativity as a process is the model by Wallas's (1926). This includes the steps of preparation, incubation, illumination and verification. Some scholars have extended the four stage model, because they suggested that the preparatory stage needs to be distinguished as problem-finding and problem-formulation (for example Getzels & Csíkszentmihályi, 1976). In more detail, Lubart (2001) reviewed existing empirical research in which he identified that the creative process incorporates many sub-processes with many steps and events. This led to a more recent definition of the creative process as a "contingent network of many sparks" (Iba, 2010, pp. 6612-6613; Sawyer, 2007, p. 105). Similarly, Johnson (2010, pp. 45-64) identified that a new idea is created by a 'liquid network'. This perspective indicates that creativity is not simply a step process, but rather a complex and dynamic network of many discoveries. Sawyer (2007) stated,

> "[Innovators] succeed by way of many small sparks, and by drawing on collaboration over time to build those sparks into something tremendous. Many of the ideas turn out to be widely off the mark, but it turns out many not-so-good ideas are needed on the way to that rare great idea." (Sawyer, 2007, p. 105)

Iba (2010) stated the network of many sparks as the contingent nature of creativity. It should be taken into account when building a theory of creativity. A simplified example of a network of interconnecting discoveries that leads to a creative outcome is presented in Figure 2-1.

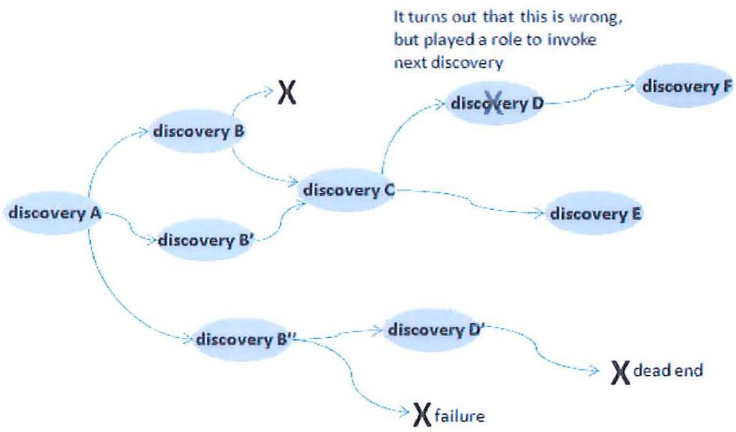



**Figure 2-1: Simplified illustration of the complex network of creativity. Adopted from Iba (2009, 2010) and originally based on Sawyer's (2007) contingent network of many sparks**

Similar to creativity, innovation has been defined as both an outcome and process.

### 2.2.2 *Definition of innovation*

Innovation has been defined as the generation, acceptance and implementation of new ideas, processes, products or services (for example Thompson, 1965). There are several definitions of innovation in several domains (Baregheh, Rowley, & Sambrook, 2009). Innovation has been defined similar to creativity as either an (1) outcome (for example product, service, process or concept) (for example Damanpour, 1996), or as a (2) process (for example Rothwell, 1994; Tidd & Bessant, 2010). Innovation as an outcome has been defined as follows:

> "[...] innovation is here broadly defined to encompass a range of types, including new product or service, new process technology, new organization structure or administrative systems, or new plans or program pertaining to organisation members." (Damanpour, 1996)

This definition perceives innovation as a concrete entity, namely, an outcome, such as a product or concept. In a literature review, Baregheh, et al. (2009) identified that the nature of this outcome incorporates novelty (new) and change. According to Schumpeter (1934) innovation is achieved as a specific social activity within the economic sphere and with a commercial purpose, while inventions can be accomplished without any intent of commercialisation. Therefore, innovation is defined as a novel and commercial outcome.

Similar to creativity, innovation has been also defined as a process (for example Tidd & Bessant, 2010). This 'process view' of innovation has been stated as follows:

> "Innovation represents the core renewal process in any organisation. Unless it changes what it offers the world and the ways in which it creates and delivers those offerings it risks its survival and growth prospects. But innovation is not an automatic attribute of organisation; the process has to be enabled through sophisticated and active management." (Bessant, Lamming, Noke, & Phillips, 2005, p. 1366)

This process definition of innovation has been viewed as a step process with the basic steps of search, select, implement and capture (Tidd & Bessant, 2010). The search step includes the identification of opportunities and creation of ideas within an innovation network. The selection stage requires to dealing with uncertainty, calculating risks and providing resources through commitment. This incorporates building business cases, coalitions and innovation portfolios (Tidd & Bessant, 2010). The implementation stage of the innovation includes the selection and development of innovation, which embraces shared and stable vision, improvisation (flexibility to change the vision in case of a better idea or failure), information exchange and collaboration under pressure (Tidd & Bessant, 2010). The last stage is the capture stage which deals with capturing and creating value. Value is captured and created through exploitation of knowledge and intellectual properties, which allows the commercialisation of the innovative outcome (Tidd & Bessant, 2010). This innovation process has been evolved from linear models of 'technology-push' ($1^{st}$ generation), 'market-pull' ($2^{nd}$) and linking technology capabilities and market needs ($3^{rd}$) to more dynamical models such as the 'rugby-approach' ($4^{th}$) and 'networked or systems-approach' ($5^{th}$) (Rothwell, 1994). Innovation as a process can be seen as a dynamic network or system, which renews existing structures of products, services, processes, systems, businesses. This renewal is accepted and preserved in society and commercially utilised.

It can be seen then that both phenomena of creativity and innovation have been defined as both an outcome and a process. The process and outcome are inseparable from each other. This requires consideration of a third perspective.

### 2.2.3 *System view of creativity and innovation*

The third perspective is the system view. This perspective combines the outcome and process into a system of creativity. This system model of creativity was introduced by Csíkszentmihályi (1990, 1996, 1999). He argues that creativity and innovation emerges only within rule-sets of recursive interactions between society, culture and the individual. In this system view, creativity and innovation are not distinct phenomena (Csíkszentmihályi, 1990, p. 209). Creativity and innovation occur when a person produces a change in a domain; a change that will be transmitted through time (Csíkszentmihályi, 1999, p. 315). Most novel ideas will be forgotten, unless gatekeeper introduce the idea into society and the domain adapts the change (Csíkszentmihályi, 1999, p. 315).This system view of creativity is illustrated in Figure 2-2.

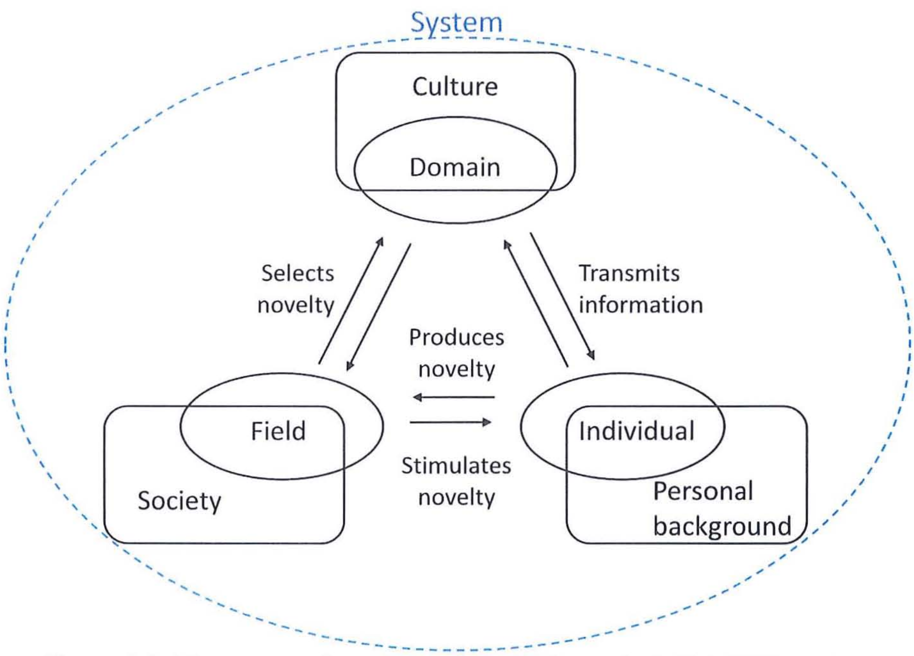



**Figure 2-2: The system view of creativity (Csíkszentmihályi, 1999, p. 315)**

The system view of creativity and innovation provides an explanation of the complexity of the relationship between the current system structures such as existing paradigms and memes ('Old') and the production of novelty and change of the system ('New') as no original thought exists in a vacuum (Csíkszentmihályi, 1999, p. 315). The 'New' emerges only in relation to the 'Old'. Csíkszentmihályi (1999) explains this as follows:

> "The 'New' is only meaningful in reference to the 'Old'. Original thought does not exist in a vacuum. It must operate on a set of already existing objects, rules, representations, or notations. One can be a creative carpenter, cook, composer, chemist or clergyman because the domains of woodworking, gastronomy, music, chemistry, and religion exist and one can evaluate performance by reference to their traditions. Without rules there cannot be exceptions, and without tradition there cannot be novelty." (Csíkszentmihályi, 1999, pp. 314-315)

This indicates that existing structures (objects, rules, representations, or notations) of a system are the precondition for novelty. These pre-existing structures of the eco-system can constrain and enable the production of novelty. For example, creativity is likely to be more difficult before a paradigmatic revolution (change of system structure), but on the other hand the need for a new paradigm makes it more likely that creativity will be hailed as such (Csíkszentmihályi, 1999, p. 320). Therefore, creativity and innovation cannot be considered in isolation from the system in which the phenomenon occurs.

Similar to Csíkszentmihályi (1990, 1996, 1999), Bakken, et al. (2009a; 2009b) and Iba (2010) investigated creativity and innovation from a system view. Both Bakken, et al. (2009a, 2009b) as well as Iba (2010, 2011) based their approach on a self-reproducing systems (autopoiesis) approach. Autopoiesis will be described in more detail in Chapter 3 on page 71. The self-reproducing system theory provides firstly, an interlinking of the 'Old' and the 'New' as self-reproducing systems pointing forwards to possible connections and at the same time connecting to previous operations (Bakken, et al., 2009a, p. 170). Secondly, the system theory provides the interlinking of the process and outcome of creativity and innovation. An autopoietic system recursively reproduces itself through its own structure and operation (Maturana & Varela, 1980, 1992). Iba (2010) describes this recursive interaction of how creativity comes about through the interaction of discovery (creative outcome) and its process of creating the discovery (creative process). This creative process is dependent on the individuals' cognitive processes and social interactions (Iba, 2010). Iba (2010, p. 6618) emphasised that the discoveries do not imply novelty in society, but can be considered as creativity. This allows re-invention to be considered as creativity too.

Similar to Csíkszentmihályi (1999), Bakken, et al. (2009a, 2009b) understand innovation as the change in the system structure, for example change in domain (innovative outcome) in relation to the process of the system to produce the novelty (innovative process). The recursive interaction of existing paradigms and reorganisation of the system is illustrated in Figure 2-3.

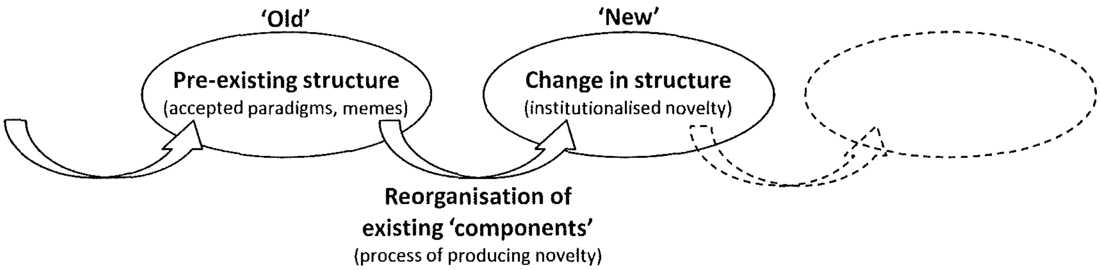



**Figure 2-3: Self-production of the system (individual, field and domain) and creativity and innovation as a change in structure. Based on Csíkszentmihályi (1990, 1996, 1999), Bakken, et al. (2009a, 2009b) and Iba (2010)**

Figure 2-3 shows how the system reproduces itself through the interaction of structure (pre-existing and establsished outcomes) and process. Within the self-reproduction, innovation occurs within the system as a function of redundancy (Bakken, et al., 2009a, 2009b). Morgan (2006, p. 105) stated this as following:

> "Any system with an ability to self-organise must have a degree of redundancy: a kind of excess capacity that can create room for innovation and development to occur. Without redundancy, systems are fixed and complete static." (Morgan, 2006, p. 105)

In other words, when a system incorporates redundancy in its categories, the system is able to change with its own components and resources. It is important to state that it is not the outcome that reproduces itself, but the system self-reproduces (autopoiesis), and this requires a change in structure to be able to produce the 'New' (heteropoiesis). For example, without new knowledge being created, no new concepts can be produced, or without a change in action within an organisation, no new products can be developed.

The difference between creativity and innovation is that creativity can be considered as the discovery at the level of individuals, while innovation can be considered as the change at the level of the organisation (society or domain) (Oldham & Cummings, 1996). Therefore, in this system view creativity can be defined as the change in structure (for example a novel and valuable idea) which is preserved because of its value within individuals' interactions (cognitive and social processes). Innovation on the other hand is the change and its preservation in the system structure of the larger system, namely, the organisation, its domain or society. For example, a new prototype, concept or idea can be judged as creative within individual interactions (e.g. groups), but without the institutionalisation, acceptance and preservation of the novelty in the organisation, market (business domain) or society, it is not an innovation. Therefore, creativity and innovation are both the change of the system structure that is preserved within the system on different levels.

### 2.2.4 *Conclusion on creativity and innovation*

This discussion indicates that creativity and innovation can be perceived from different perspectives. The definitions of the concept of creativity and innovation as either an outcome or a process provide important insights into the phenomenon, but each tells only 'one side of the coin'. The system view of creativity and innovation allows researchers to interlinking the process and outcome (change in structure) and the past ('Old'), actual and possible ('New'). This view permits investigation of the complex phenomenon of creativity and innovation as a whole (Iba, 2010). The discussion established the perspective of creativity and innovation, which is relevant for this study. The next consideration for this study is the organisational theories related to knowledge, creativity and innovation.

## 2.3 Organisation of knowledge, creativity and innovation

The investigation of the organisation of knowledge, creativity and innovation has been investigated by several scholars from several perspectives. This section briefly discusses the definition of knowledge and several studies of the knowledge-based view of the organisation, innovation models and knowledge creation in organisation. The organisation (both 'the organisation' and 'organising') of knowledge, creativity and innovation includes the multiple-levels such as individuals, groups and the organisation and several contextual influence factors. This section discusses and provides an overview of the complexity inherent in an organisation, which need to be taken into account when investigating the organisation of knowledge, creativity and innovation.

### 2.3.1 *Definition of knowledge*

The discussion about knowledge goes back to the ancients and has been defined in several ways. For example, Von Krogh (1998) stated that there are two main perspectives on knowledge: (1) cognitivist perspective and (2) constructivist perspective. The perspective taken in this thesis is the constructivist perspective. In this perspective knowledge is seen as 'justified true beliefs' and depends on the unique viewpoint, personal sensemaking and individual experience (Von Krogh, 1998, p. 134). The validation process of cognition towards knowledge for an scientific account of the constructivist view ('first-person' to 'third-person position') has been investigated and discussed by Depraz, Varela, & Vermersch (2003) and Varela & Shear (1999). In this research knowledge is considered as being created by one's mind, embodied in the human senses and previous experience, and is referred to as 'justified beliefs'.

### 2.3.2 *Different models of organisation of knowledge, creativity and innovation*

Creativity and innovation are facilitated through the organisation of individuals, technologies and resources in such a way that new, viable and feasible knowledge, ideas and solutions are created, developed, institutionalised and commercialised. For example individuals organise themselves to create new knowledge within in interaction with the world and between individuals (Nonaka & Takeuchi, 1995; Nonaka, et al., 2008). Several other scholars have pointed to self-organisation of communities of practice that lead to new knowledge exploration, creativity and innovation (Amin & Roberts, 2008a; Davenport & Hall, 2002). This organising that facilitates creativity and innovation has been studied and has identified several factors within cognitive processes, human interaction and social and regulatory structures (Nooteboom, 2000; Tidd & Bessant, 2010; Zhou & Shalley, 2008). A more recent approach of organisation is open innovation, which argues that for both the creation and commercialisation a system needs to interact with end users as discussed by Hippel (1988, 2005) and customers as discussed by Chesbrough (2003, 2006). An overview of different models and concepts of organisation of knowledge, creativity and innovation is presented in Table 2-1.

| **Models of organisation** | **Concepts** | **Scholars** |
|---|---|---|
| Sensemaking and organising | Sensemaking and organising from process | Daft & Weick (1984); Weick (1995) |
| 'Systems of shared meaning' | Influence of culture (structure) on process and outcome | Smircich (1983) |
| Viable systems (self-referential systems) | Recursive interaction with environment to adoption of changing environment | Beer (1984, 1985) |
| Learning systems (single and double loop learning) | Reflective learning about action and governance to continuous improve (first and second order cybernetics) | Argyris & Schön (1996); Argyris (1999) |
| System-thinking system | Organisational capabilities and disciplines of learning | Senge (1990, 2006) |
| Information-based system | Organisational construction of knowledge and meaning | Choo (2006) |
| Knowledge-creating systems (SECI model and Ba) | Tacit knowledge as source of creativity and innovation; spatial knowledge and shared context creation within the organisation; organisational knowledge creation | Nonaka & Takeuchi (1995); Nonaka, Toyama, & Hirata (2008) |
| Distributed knowledge systems | Knowledge-based view of the organisation, disciplines, practices and structure of knowledge creation | Grant (1996); Tsoukas (1996); Von Krogh & Roos (1996) |
| Knowledge-centric systems | Learning about learning in organisations | Stonehouse & Pemberton (1999); Pemberton & Stonehouse (2000, 2005) |
| Communities of practices, social networks and online communities | Communities of practice and the creation of knowledge, creativity and innovation | Amin & Roberts (2008a, 2008b); Davenport & Hall (2002); Hall & Graham (2004); Wenger (1998); Wenger, McDermott, & Snyder (2002) |
| Open and co-creating systems | Open innovation, user groups and co-creation to generate customer and user innovation | Chesbrough (2003, 2006); von Hippel (1988, 2005); Prahalad & Ramaswamy (2000); Ramaswamy & Gouillart (2010) |

**Table 2-1: Different models of organisation and knowledge creation, creativity and innovation**

| Models of organisation | Concepts | Scholars |
|---|---|---|
| Creative and innovative systems | Disciplines, practices, structures and organisation of creativity and innovation | Amabile (1996c, 1998); Bendixen (1976); Csíkszentmihályi (1990, 1999); Jaworski & Zurlino (2009); Nooteboom (2000); Sawyer (2007); Sutton (2007); Teece (2009); Tidd & Bessant (2010); Woodman, et al. (1993); Zhou & Shalley (2008); |
| Spatial constructed systems (autopoietic systems) | Spatial construction of organisation | Hernes (2004a, 2004b); Also: Amin & Roberts (2008a); Crang & Thrift (2000); Nonaka, et al. (2008); Thrift (2006, 2008a) |
| Self-producing systems (autopoietic systems) | Autopoietic systems of knowledge creation and innovation | Bakken, et al. (2009a, 2009b); Bakken & Hernes (2003a); Hernes (2007); Luhmann (2000); Maula (2006); Magalhães & Sanchez (2009a); Zeleny (2004, 2006) |

**Continuing Table 2-1: Different models of organisation and knowledge creation, creativity and innovation**

Table 2-1 shows that the several studies of the organisation of knowledge, creativity and innovation incorporate many diverse activities. All of these studies incorporate the aspect of human organisation of knowledge creation and creativity and utilisation towards innovation. These models and concepts provide a valuable insight of into how to organise the creation of new knowledge, create new and valuable ideas and institutionalise and commercialise them. Therefore, knowledge creation towards new and valuable ideas to be able to successfully invent, institutionalise and commercialise products, services, processes, systems and businesses is crucial.

### 2.3.3 *Knowledge creation and innovation*

One of the most cited knowledge creation models in the theory of organisation of innovation is the SECI model by Nonaka & Takeuchi (1995). This model incorporates four modes of knowledge creation (Nonaka & Takeuchi, 1995, pp. 62-70; Nonaka, et al., 2008, pp. 18-26). 'Socialisation' is the acquisition of 'tacit knowledge' through observation, imitation and practice. 'Externalisation' is the conceptualisation [explicit knowledge] of an image [tacit knowledge] through the use of metaphor and analogy. 'Combination' embraces the combination of 'explicit knowledge' through the use of media. 'Internalisation' is the process of embodying 'explicit knowledge' through 'learning by doing'. The 'tacit knowledge' (embodied knowledge) has been identified as the key source of innovation, which is converted into the expression or utterance of an idea or concept ('explicit knowledge') (Nonaka & Takeuchi, 1995). Within the interaction between individuals and the environment, the beliefs of individuals become public and can be justified and therefore knowledge can be created (Von Krogh, 1998).

The model has been criticised for the separation of the 'explicit' and 'tacit knowledge' (Adler, 1996; Tsoukas, 2003). Adler (1996) as well as Tsoukas (2003) stated that Polanyi (1958, 1966) argued that explicit and tacit knowledge are not two distinct types of knowledge, but rather inseparable and necessary components of all knowledge. In this sense, 'tacit knowledge' is always necessary for 'explicit knowledge' to be understood (Adler, 1996). Nonaka & von Krogh (2009, p. 636) stated in a recent article that 'explicit' and 'tacit knowledge' are not separate, but rather two ends of the same continuum. 'Explicit knowledge' is accessible through consciousness and 'tacit knowledge' is knowledge such as tactile experience, movement skills, intuition, unarticulated mental models or implicit rules of thumb (Nonaka & von Krogh, 2009, p. 636). From a cognitive process perspective, tacit and explicit knowledge are inseparable, because of the self-referential (autopoiesis) function of cognition (Maturana & Varela, 1980, 1992). Nonaka & Takeuchi (1995, p. 61) pointed out that the conversion from 'tacit' to 'explicit' knowledge is a social process between individuals and should not be confined within an individual (Nonaka & Takeuchi, 1995, p. 61). From a social process point of view, the four modes of knowledge creation within interactions of among individuals can exists separately, but each mode is dependent on the individuals' knowledge creation in which 'tacit' and 'explicit' are inseparable. The definition of knowledge types is misleading, one should rather referred it as shared context (shared knowledge) between individuals. The SECI process of social interaction of among individuals builds a self-referential cycle of 'organisational knowledge creation' (shared context) (Zeleny, 2004, 2006). This shared context influences the individual knowledge creation and the individual knowledge creation builds the shared context as shown in Figure 2-4.

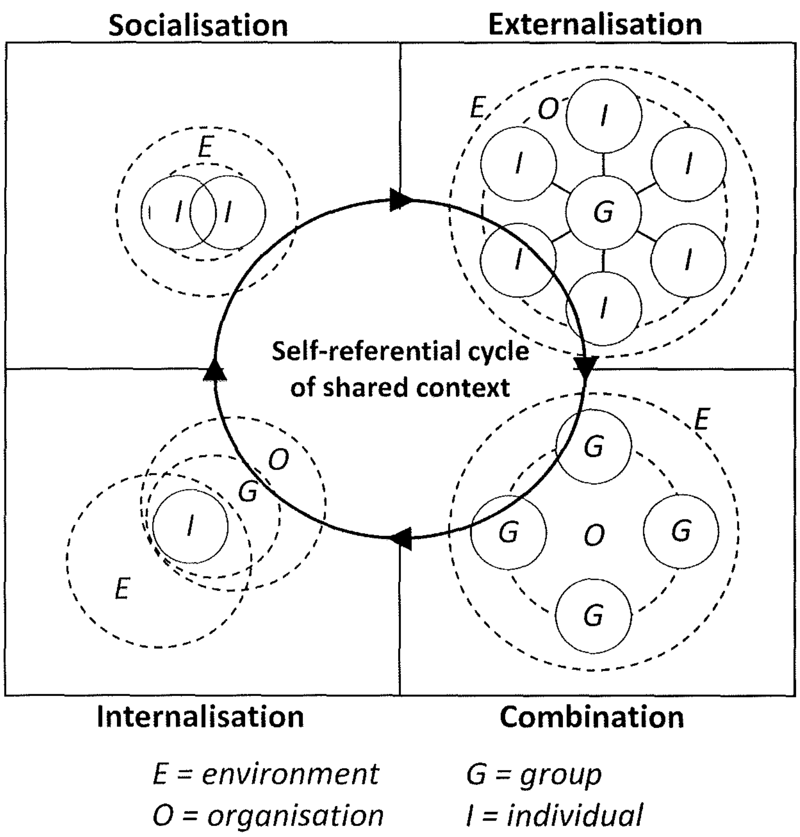



**Figure 2-4: Self-referential cycle of knowledge creation in organisation (SECI model). Adopted from Nonaka, et al. (2008, p. 19) and Zeleny (2006, p. 12)**

Figure 2-4 illustrates how individuals reproduce shared understanding within a system such as an organisation. The knowledge types should not be seen as two types of knowledge, but rather two momentary states within the organisational knowledge creation process. The tacit type is the personal knowledge of an individual, while the explicit type is the shared context (mental system structure) of the organisation, which in turn influences the knowledge creation of the individual (tacit). This builds the S-E-C-I spiral.

New knowledge (novelty) emerges within the system as a function of redundancy such as redundancy of communication (Bakken, et al., 2009a), unusual communication channels, self-organisation and fuzzy divisions (Nonaka & Takeuchi, 1995, pp. 80-82; Takeuchi & Nonaka, 1986), parallel processing and information sharing (Morgan, 2006, pp. 105-108) and the design principles of 'redundancy of parts' and 'redundancy of function' (Emery, 1999, pp. 107-109).

The issue with this knowledge creation model is that it does not explain how creativity and innovation emerges. The SECI model has been stated to falls short on four accounts related to creativity (Bereiter, 2002, pp. 160-161). Firstly, the model does not explain how minds produce original ideas (Bereiter, 2002, pp. 160-161). Secondly, the model fails to explain understanding, misunderstanding and depth of understanding, which limits the explanation of productive creativity (Bereiter, 2002, pp. 160-161). Thirdly, the model has little to say about the production, management, improvement or application of knowledge abstracted from practice, which is an important function in the creative cognitive process. Lastly, it lacks an explanation of the knowledge creation of producing, for example, a design through the emergent of progressive discourse (Bereiter, 2002, pp. 160-161). Others have argued similarly that the model falls short on explaining innovation (for example Engeström, 1999; Gourlay & Nurse, 2005). Gourlay & Nurse (2005) stated that it provides an explanation of how pre-given conditions and knowledge is represented but fail to explain innovation. Furthermore, creative ideas are often routinely rejected (Mueller, Melwani, & Goncalo, 2012; West, 2002a). The SECI model does not take into account that creative ideas are often rejected routinely in organisations. Therefore, to build a theory of creativity and innovation the model requires an explanation of the conditions and processes for creativity and innovation.

### 2.3.4 *Organisation of creativity and innovation*

In the social science creativity and innovation has been researched in three major domains, namely, (1) psychology (for example Runco, 2007; Sternberg, 1999; Weisberg, 2006), (2) sociology (for example Amabile, 1996a; Csíkszentmihályi, 1990, 1999; Paulus & Nijstad, 2003; Perry-Smith, 2002, 2006, 2008; Perry-Smith & Shalley, 2003) and (3) organisational research (for example Amabile, 1998; Amabile

& Kramer, 2011; Andriopoulos, 2001; Woodman, et al., 1993; Zhou & Shalley, 2008). There are further disciplines such as technology, neuroscience and education, which investigate creativity.

A model of organisation of creativity that incorporates the complexity of individuals (psychology), social interactions of individuals such as groups (sociology) and organisation (organisational and management research) was introduced by Woodman, et al. (1993). The model indicates that creativity within a system such as an organisation is influenced by the personal influence factors of individuals, social influence factors within interactions among individuals' interactions and the contextual influence factors of the organisation as presented in Figure 2-5.

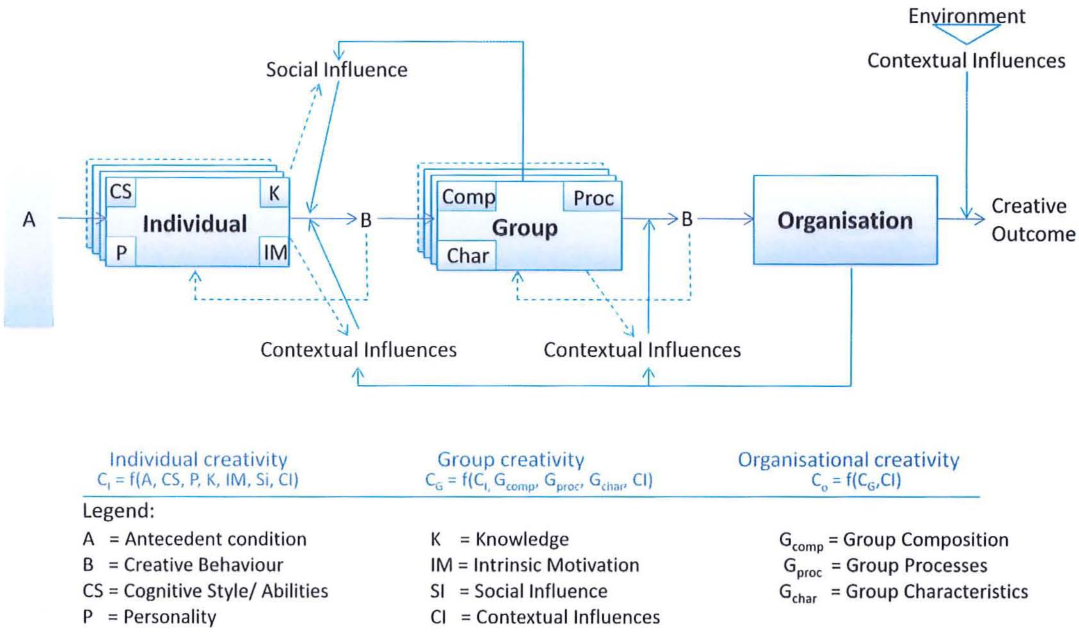



**Figure 2-5: An interactionist model of organisational creativity (Woodman, et al., 1993)**

Figure 2-5 indentifies firstly the multiple-level complexity of creativity within an organisation and secondly shows that creativity at each level is influenced by (1) personal, (2) social and (3) contextual factors.

### 2.3.5 *Multiple level complexity of organisation*

The multiple-levels are divided into macro and micro levels. Based on the doctrine of Durkheim (1952), Jones (1995) distinguished the macro level as the social structure and the micro level as interactions of individuals. The macro level deals with the large social units of a system and interactions of societal scope, while the micro level deals with small social units such as groups and interactions among individuals. This distinction is presented in Table 2-2. The structure of a system (macro level) incorporates phenomena such as shared culture, behaviour, regulations, defined repeating repetitive processes and shared context or understanding. The individual interactions (micro level) consist of phenomena such momentary situations and events of individual interactions, individual knowledge creation while interacting with the environment, and individual actions and behaviours.

| Micro | Macro |
|---|---|
| individuals | populations |
| small social units | large social units |
| individual interactions of limited scope | interactions of societal scope |
| interaction among individuals | repeated experiences of large numbers of people across time and space |
| represented by empirical indicators for individual actors | constructed by the aggregation of such indicators |
| level of psychological propositions | propositions about larger-scale social processes and structures |
| social processes underlying relations among individuals | constraints of social structure in a group (population) on individual interaction |

**Table 2-2: Macro-micro level distinction (Jones, 1995)**

The model of organisational creativity (see Figure 2-5) shows that the structure of the organisation (macro level) influences the cognitive processes and social interactions of individuals (micro level). At the same time the individual interactions (micro level) constitute the structure at the macro level (Bakken & Hernes, 2003b; Fuchs, 2003; Goldspink & Kay, 2009). Hedström & Swedberg (1998, p. 21) argue that understanding change in the social system requires understanding of "how macro states at one point in time influence the behaviour of individual actors, and how these actions generate new macro states at a later time." Scholars such as Giddens (1979, 1981, 1984), Luhmann (1995) and Fuchs (2002, 2003, 2008; Fuchs & Hofkirchner, 2009) provide an explanation of the macro-micro interaction in social systems. Also the SECI model by Nonaka & Takeuchi (1995) provides an explanation of the interaction between micro (individuals - tacit) and macro level (organisation -

explicit). The interaction of between the macro and micro level in social systems will be discussed in detail in section 3.4.3 on page 86. For the understanding of creativity and innovation, the multiple levels and multiple influence factors need to be taken into account.

### 2.3.6 *Complexity of organisation of creativity and innovation*

For the organisation of creativity and innovation, the multi-level complexity of macro and micro level and the complexity of multiple influence factors of personal, social and contextual influences need to be taken into account.

The macro level of the organisation of creativity and innovation includes such phenomena of organisational culture, climate and encouragement, leadership practices and supervisor support, systems and structures and resources (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Andriopoulos, 2001; Andriopoulos & Dawson, 2009). The individual interactions or the micro level of creativity and innovation embraces processes of social interactions and cognition which are regulated by the organisational system (for example Drazin, Glynn, & Kazanjian, 1999; Paulus & Nijstad, 2003). This complexity of macro-micro and multiple influences is presented in Table 2-3.

| | | **Personal influence** | **Social influence** | **Contextual influences** |
|---|---|---|---|---|
| **MACRO** | **Organisation** | information and knowledge resources, shared context and understanding | leadership, shared behaviour, climate, communication and routines | structure, workplace, resources, processes and infrastructure |
| **MICRO** | **Group** | shared understanding and diverse views and opinions | social interactions, group processes and group characteristics | group composition (diverse groups) |
| | **Individual** | motivation, skills and knowledge | individual norms and values | job responsibility |

**Table 2-3: Matrix of micro/macro levels and personal, social and contextual influences**

The table exemplifies the influence factors on both the macro and micro level. These influences will be discussed in detail on at both the macro and micro level in sections 2.4 (page 48) and 2.5 (page 53) and section 2.6 (page 58).

### 2.3.7 *Conclusion on organisation of knowledge, creativity and innovation*

The organisation of knowledge, creativity and innovation has been investigated by many scholars, who have widely contributed to the topic. At the heart of the domain are the knowledge creation and creative and innovative ability. The knowledge creation model by Nonaka & Takeuchi (1995) provide an explanation of how new knowledge is created in organisations. In this model redundancy such as fuzzy structures and mechanisms to establish new communication channels is essential for new knowledge such as new ideas (Nonaka & Takeuchi, 1995, pp. 80-82). Redundancy alone does not explain the complexity inherent in the creative and innovative process and how creativity and innovation emerges within an organisation. Therefore, the organisation as a system needs to incorporate the complexity of individual and group creativity ('organising') and the organisational context ('the organisation') that facilitate creativity and innovation. This is essential for the discussion of how creativity and innovation emerges in organisations. The first discussed in more detail is the individual creativity.

## 2.4 Individual creativity

Individual creativity is a widely researched domain (for example Amabile, 1996a; Runco, 2007; Sternberg, 1999; Weisberg, 2006). Individual creativity incorporates influential factors such as (1) intrinsic motivation, (2) domain-relevant skills and (3) creativity-relevant processes (Amabile, 1996a; Amabile & Mueller, 2008).

### 2.4.1 *Intrinsic motivation*

Intrinsic motivation has been identified as conducive to individual creativity by scholars such as Deci (1971, 1972) and Amabile (1985, 1996a, 1996c). Amabile

(1996a, p. 119) identified the intrinsic motivation principle of creativity. She expressed this principle as following:

> "Intrinsic motivation is conducive to creativity; controlling extrinsic motivation is detrimental to creativity, but informational or enabling extrinsic motivation can be conducive, particularly if initial levels of intrinsic motivation are high." (Amabile, 1996a, p. 119)

This indicates, firstly, that intrinsic motivation is an enabler of creativity. Secondly, Amabile (1985, 1996a, 1996c) argues extrinsic motivation such as expected evaluation and contracted-for reward can have a negative effect on creativity as it establishes a controlling environment, but when confirming competence without controlling it, a motivational synergy with intrinsic motivation can be established.

Intrinsic motivation has been linked with creativity through the flow model by Csíkszentmihályi (2008). Csíkszentmihályi (2008, pp. 71-77) argues that different states of the mind such as anxiety and boredom prevent individuals from accomplishing a creative performance. In contrast, flow is a completely focused motivation, and is mostly achieved when performing a task for intrinsic purposes. The flow state occurs within a particular ratio between the challenge and skill level as presented in Figure 2-6.

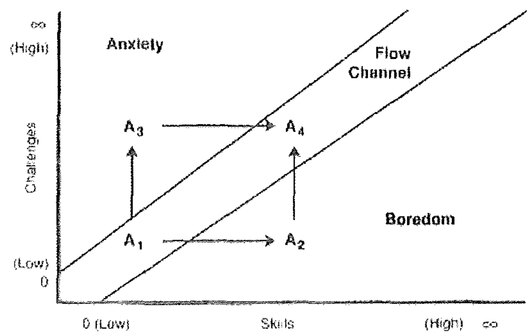



**Figure 2-6: Challenge and skill ratio and flow channel (Csíkszentmihályi, 2008, p. 74)**

This flow channel is mostly triggered by intrinsic purpose and can be established in an environment of autonomy (sense of choice, volition and self-determination), competence (ability to influence important outcomes), and relatedness (satisfying and supportive social relationships) can facilitate intrinsic motivation and creativity (Deci & Ryan, 1985; Pink, 2009; Stone, Deci, & Ryan, 2009). Conclusively, one could say that,

> "the desire to do something because you find it deeply satisfying and personally challenging inspires the highest levels of creativity" Amabile cited in Pink (2009, p. 116)

### 2.4.2 *Domain-relevant skills: Expertise, skills and knowledge*

In addition to intrinsic task-motivation, to accomplish a creative performance one requires task-relevant skills such as knowledge, expertise, technical skills and talent in a particular domain (Amabile & Mueller, 2008, p. 35). Individual creativity occurs in the "place where the things we love to do and the things we are good in come together" (Robinson & Aronica, 2009, p. 1). To be good at something one needs to acquire relevant-skills.

Weisberg (2006, pp. 197-198) states that extensive practice is positively related to world-class performance, but one needs to distinguish between the reproduction of action into perfection (mastery) and the performance of change of structure or characteristics of actions (creativity). Both mastery as well as creativity requires a tremendous amount of information available to process, which were acquired through extensive practice (Weisberg, 2006, pp. 197-202). Similar, Amabile (1996a, pp. 102-107) illustrates that domain-relevant skills such as expertise and skills are necessary to create a 'correct' response (appropriate or valuable). This relates to 'selective encoding', which occurs when an individual recognises the importance of a piece of information relevant to the solution or discovery within his/her environment (Weisberg, 2006, pp. 536-541).

The issue with experience to create a solution or new idea is the issue of fixation (Weisberg, 2006, pp. 282-340). Fixation is the attachment or too-strong reliance on the past (Weisberg, 2006, p. 296). This incorporates two paradox views, namely, 'tension view' and 'foundation view' (Weisberg, 2006, pp. 52-54; 203-207; 302). The 'tension view' incorporates overcoming fixation by breaking away from the past (Weisberg, 2006, p. 206). The 'foundation view' consists of the doctrine that new ideas come about as the result of an individual's building on old ideas (Weisberg, 2006, p. 206). Both ways can enable individuals to generate a creative idea.

Domain-relevant skills are required to overcome fixation, selecting relevant information and, generate appropriateness as well as validation of the level of novelty while comparing it to existing approaches. Nevertheless, knowledge and creativity can be a 'double-edged sword', because of the 'functional fixedness' (fixation) and its necessity to recognise important information. This discussion shows that domain-relevant skills are required, but are not an adequate precondition alone for creativity. It requires also knowledge of how to generate creative ideas, which relates to creative-relevant processes.

### 2.4.3 *Creativity-relevant processes: Thinking styles and knowledge processing*

Many scholars have identified several thinking styles that are conducive to creativity. In academic literature there are two different knowledge types or thinking styles related to creativity, namely 'ordinary thinking' and 'extraordinary thinking'. Creativity can be the result of 'ordinary thinking' by deliberate processing and methodological problem solving (for example Boden, 2004; Sternberg & Lubart, 1999; Weisberg, 2006). In contrast, many scholars have identified 'extraordinary thinking', which can result in the generation of a creative idea. Runco discusses several 'extraordinary thinking' concepts (Runco, 2007, pp. 1-38). Several concepts of creative thinking are presented in Appendix A (page 357). These thinking styles have been seen as a contradiction.

Instead of seeing the two views of thinking style as a contradiction, Dietrich (2004a) unified the two into a model of four basic types of creative insights. Dietrich (2004a, p. 1015) stated that creativity can occur within two modes of processing, deliberate or spontaneous, and two structures, emotional or cognitive. The model is presented in Figure 2-7. However, a given creative act is not suggested to be the manifestation of one of these four types in pure form (Dietrich, 2004a, p. 1015).

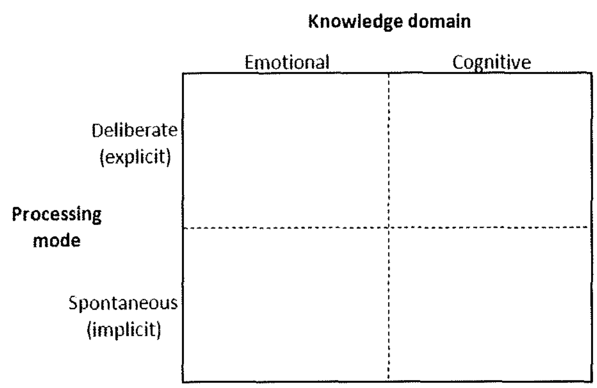



**Figure 2-7: Four basic types of cognitive creativity (Dietrich, 2004a)**

The deliberate-mode is the processing-mode of ordinary thinking and creative ideas tend to be structured, rational, and compliant with the inherent values and belief systems of the individual (Dietrich, 2004a, p. 1016). This mode is based on processing such as long-term memory retrieval, semantic retrieval, episodic retrieval autobiographical retrieval, priming and explicit categorisation (Dietrich, 2004a, p. 1016). These retrieval processes of information allow the formation of new combinations though step-wise processing. The deliberate mode of creativity requires focus, as humans appear to be able to process only limited numbers of items (Csíkszentmihályi, 2008, pp. 28-33; Dietrich, 2004a, p. 1017). Therefore, information or a situation with greater complexity can lead to information overload. In such conditions, the generation of creative ideas within a step-wise processing requires focus and little distraction.

The spontaneous mode is the underlying mechanism of intuition and flashes of insights, which incorporates phenomena such as daydreaming and incubation (Dietrich, 2004a, p. 1016). Dietrich stated that

> "spontaneous insights occur when the attentional system does not actively select the content of consciousness, allowing unconscious thoughts that are comparatively more random, unfiltered, and bizarre to be represented in working memory." (Dietrich, 2004a, p. 1016)

This mode allows large amounts of information processing, because the unconscious brain is able to constantly combine information and to retrieve task-relevant information from its long-term memory (Dietrich, 2004a, pp. 1016-1017). The model of four modes of creative insights indicates that creativity can occur through both 'ordinary thinking' (deliberate processing) and 'extraordinary thinking' (spontaneous processing).

### 2.4.4 *Conclusion on individual creativity*

Individual creativity is dependent upon the individual's interest (intrinsic motivation), past experience and prior knowledge (domain-relevant skills) and knowledge processing modes that are conducive to creativity (creative-relevant processes). This discussion indicated that creativity emerges within an individual under several conditions. These conditions need to be facilitated within groups and organisations for a creative performance and to produce a creative idea. This links to the next section of group creativity as creativity is not only a cognitive phenomenon, but also a social phenomenon, which led to the investigation of interactions of individuals and group creativity.

## 2.5 Individual interactions and group creativity

Creativity has been investigated from the perspective of interaction between individuals and groups. In academic literature there are three main categories of group creativity, namely (1) group composition, (2) group characteristics and (3) group processes (Woodman, et al., 1993). These three categories of group creativity will be discussed in detail in this section.

### 2.5.1 *Group composition*

Creativity in groups is influenced by the group composition. Milliken, et al. (2003) argue that diverse groups outperform homogeneous groups as well as non-interacting individuals on creative tasks as they can draw on a greater range of skills and resources. Homogenous groups on the other hand are more effective, but less creative (van Oudenhoven-van der Zee, Vos, Paulus, & Parthasarathy, 2009). Similarly, McLeod, Lobel, & Cox Jr (1996) identified that ethnically diverse work teams have potential advantages in creative performance over homogeneous teams. Nemeth & Nemeth-Brown (2003) stated that diversity is complex. Diversity such as ethnicity, gender or race does not necessarily imply both a difference in perspective and expression and maintenance of these different perspectives. Group members frequently strive for unanimity, which leads to their motivation to realistically appraise alternative courses of action being overridden (Janis, 1982). Janis (1982) named this collective mode 'groupthink'. To avoid the effect of 'groupthink' diverse knowledge and opinions must be voiced and maintained to stimulate creativity (Nemeth & Nemeth-Brown, 2003).

The voicing and maintaining of diverse viewpoints, values or worldview can often result in conflict (for example Bassett-Jones, 2005; Milliken, et al., 2003). Milliken & Martins (1996, p. 403) stated the following:

> "Diversity, thus appears to be a double-edged sword, increasing the opportunity for creativity as well as the likelihood that group members will be dissatisfied and fail to identify with the group." (Milliken & Martins, 1996, p. 403)

This shows that diversity comprises the potential of disintegration of group members, conflict and creativity. The contributions of diverse perspectives to creativity are firstly overcoming fixation and context shifting (Smith, 2003). Secondly, diverse dissents can act as inspiration or a stimulator of creative thought when expressed and maintained (Nemeth & Nemeth-Brown, 2003). Thirdly, multiple viewpoints from multiple members create a more original, complex, innovative outcome and of higher quality (Milliken, et al., 2003). This requires avoiding disintegration of members, conflict and 'groupthink' to facilitate group creativity, which requires certain group characteristics.

### 2.5.2 *Group characteristics*

Diverse opinions and viewpoints can result in both creativity as well as group conflict. Therefore, group cohesiveness plays a key role. Nakui, Paulus, & Van Der Zee (2011) identified that the group characteristic of a positive attitude towards diversity is important for fully tapping into the creative potential of groups. Similarly, Hennessey & Amabile (1998) state that diversity requires relationships of trust and the understanding of several individuals' strengths and weaknesses to enhance creativity in problem-solving. Group cohesiveness is dependent on mutual respect and interpersonal trust, which allows a group behaviour, in which the group will not reject, punish or embarrass a member for speaking his/her opinion (Edmondson, 1999). Furthermore, tolerance of ambiguity enables individuals to avoid mental ruts in group discussions (West, 2003). These different group characteristics should not lead to 'groupthink', but should allow an environment in which conflict can be solved creatively.

Another phenomenon relates to group characteristics: 'weak ties' (less frequent interaction) in social networks allows interactions between different groups and communities (Granovetter, 1973) and corresponds with high creativity (Perry-Smith & Shalley, 2003, p. 95). The assumption behind the effect of high creativity is that 'weak ties' within interactions among individuals prevent the automatic confirmatory within a group (Perry-Smith & Shalley, 2003, p. 95). This implies that groups with the characteristic of 'weak ties' can prevent the group confirmatory and can therefore facilitate creativity. Furthermore, weak ties can build groups of 'intersections' of fields, domains and cultures (interdisciplinary groups). This can lead to creativity and innovation (Johansson, 2006).

Furthermore, leadership of the group has been identified as an influence factor. West (2003) proposed that team leaders play a key role in team processes to produce innovation. A dominant and directive leader may prevent change by reducing the team members' confidence and preventing innovation initiatives (West, 2003). Similarly, groups can tap into 'groupthink' when group leaders inherit the attributes of strong and opinionated leadership behaviour (Nemeth & Nemeth-Brown, 2003). This implies that creative teams need a neutral and guiding team leader.

Another influence of group creativity is the group size. Group size can affect motivation as well as distraction and anxiety (Paulus & Brown, 2003, pp. 114-115). Dennis & Williams (2003) identified the effects of group size in both verbal groups and groups with electronic communication in brainstorming sessions. They stated that the size of the group can change the group process dramatically. Large groups (for example group size above 25 members) should use web-based brainstorming tools (e.g. idea portals) and smaller groups (group size between 3 to 5 members) should use verbal techniques to gain group focus and facilitate group creativity (Dennis & Williams, 2003). These group characteristics are closely linked to the group processes.

### 2.5.3 *Group processes*

There are several group processes involved within group or collective creativity. West (2003) summarised the group processes as the development of shared objectives, participation, conflict, support for innovation, reflexivity, safety and leadership. The first group process embraces the steps from disagreements to the construction of a creative solution and shared objective (West, 2003, pp. 261-263). A high level of participation supports these processes and increases the likelihood of openness to change (West, 2003). Such interactions between individuals incorporate constructive controversy, in which mutual inspiration can lead to a creative solution.

Another challenge in groups is that an innovative idea may be routinely rejected within a collective (West, 2003, pp. 263-264). Therefore, group processes such as expectation, approval and practical attempts to introduce new ways of doing things are required (West, 2003, pp. 263-264). Furthermore, the processes of constructive controversy, redirecting goals, expressing unusual ideas and group reflectivity need psychosocial safety (West, 2003, pp. 264-265). Psychosocial safety or 'team safety' occurs when individuals are free from pressure, feel safe and experience a relatively positive effect (Edmondson, 1999).

The last team processes identified by West (2003) are the leadership processes. The transactional leadership practices are based on rewards and punishment, while transformational leadership practices require encouragement. The effects of transactional leadership can have negative effects on creativity, while transformational leadership has positive effects as discussed by Pink (2009). Transformational leadership practices changes the behaviour of the group from self-interest to consideration of the whole group (West, 2003).

The most important processes within an individual's interactions are the communication processes. During face-to-face conversations there are two different functions of communication as discussed by Josephsson, Asaba, Jonsson, & Alsaker (2006). The first function is the 'narrative communicating order', which incorporates a logic mode based on experience or historical slopes that give order and direction. The second is 'narrative communicating creativity', which includes emplotment that moves towards the possible within a myriad of contradictory opinions. This emplotment establishes a 'possibility room' or space for interpretation and change (Josephsson, et al., 2006). The first mode can be seen as logical and effective information exchange, while the second mode is the playful and creative mode.

This mode of creativity within the interactions of individuals is referred to as dialogue by scholars such as Bohm & Peat (2011) and Bakhtin (1981 [1930s]). The term dialogue is derived from the Greek words, 'dia' meaning 'through' and 'logos' signifying 'the word' (Bohm & Peat, 2011, p. 240). Bohm & Peat (2011) stated the relationship between dialogue and creativity as following:

> "[...] it is proposed that a form of free dialogue may well be one of the most effective ways of investigating the crisis which faces society, and indeed the whole human nature and consciousness today. Moreover, it may turn out that such a form of free exchange of ideas and information is of fundamental relevance for transforming culture and freeing it of destructive misinformation, so that creativity can be liberated. However, it must be stressed that what follows is not given in the spirit of a prescription that society is supposed to follow. Rather it is an invitation to the reader to begin to investigate and explore in the spirit of free play of ideas and without the restriction of the absolute necessity of any final goal or aim." (Bohm & Peat, 2011, p. 240)

This dialogue permits non-judgmental, exploring, synergic, inquiring, divergent, trustful and creative conversations (David, 1998). Björkman (2004) identified that moderated dialogue conversations allow engagement in the task; everybody is heard within the group and individuals exchange ideas and experience. The dialogue is contrasted with the sacrosanct tradition (monologism). Ultimate truth (monologism) does not allow room for alternatives, which leads to the loss of freedom (Bakhtin, 1981, pp. 17-18). Dialogue in contrast provides discourse through interaction of various social languages or intertextuality of utterances or texts, which allows multiple perspectives and the generation of numerous possibilities (Bakhtin, 1981, pp. 281-283). This discourse of dialogue of different viewpoints from different utterances and texts can be seen as the redundancy (new knowledge creation) within a system of shared understanding. Such a form of social interaction is based on Buber's (1970 [1923]) authentic relationship between man and man; the 'sphere of between' ('Zwischenmenschliche') (Friedman, 2007, pp. 98-99). This authentic relationship is, according to Buber, the I-You relationship, which is facilitated by the genuine dialogue, which has the essence of 'seeing the other' or 'experiencing the other side' within spoken or silent interaction (Friedman, 2007, pp. 100-104). One cannot directly experience the other, but can relate to him/her. This is clear from the monological man who tries to incorporate the other into himself, rather than letting him/her exist only as one's own experience, only as a part of oneself (Friedman, 2007, p. 103).

### 2.5.4 *Conclusion on individual interactions and group creativity*

Creativity is situated within the events of interaction among individuals. Within these events, creativity can be facilitated through certain compositions, characteristics and processes during interaction between individuals. Such individual interactions are crucial for the production of creative ideas and innovation (Sawyer, 2007). Certainly, there are several more personal, social and contextual influence factors on group creativity. However, factors identified here provide an overview of the complexity of interactions between individuals in which creativity can occur. These daily interactions are determined by the cultivated and shared knowledge, behaviours and guidelines and, the structure of the organisation.

## 2.6 Organisational innovation capability

'The organisation' (macro level) in relation to creativity and innovation has been investigated by many scholars (for example Amabile, et al., 1996; Andriopoulos, 2001; Andriopoulos & Dawson, 2009; McLean, 2005; Woodman, et al., 1993; Zhou & Shalley, 2008). Andriopoulos (2001) reviewed the literature on the organisational factors influencing creativity. He identified five major factors including organisational climate, leadership style, organisational culture, resources and skills, and structure and systems. Similar, factors such as leadership, social networks, climate and culture, and collective process such as feedback and sensemaking were identified and discussed (Zhou & Shalley, 2008). These organisational factors (macro level) create conditions, which enhance creativity both at the team as well as the individual level (micro level) (Andriopoulos, 2001, p. 838). This section discusses the several categories of the capability of the organisation that relates to creativity and innovation.

### 2.6.1 *Information resources*

From an organisational perspective, information resources are a crucial part of its innovation capacity. The capacity of an organisation to acquire and transfer external information throughout the organisation is crucial for the creation of innovation (Cohen & Levinthal, 1990; Ward & Peppard, 2002, pp. 466-467). This information sharing is part of the organisational creation of shared context, which is an essential function of the transformation of individuals' ideas into innovative outcomes (Nonaka & Takeuchi, 1995). Furthermore, information within the innovation process of an organisation is required for the creation new knowledge, validation of ideas and support of decision-making (Choo, 2006, pp. 1-28; Ward & Peppard, 2002, pp. 424-462). Information resources are one side of knowledge creation, the other is knowledge resources.

### 2.6.2 *Knowledge resources*

Knowledge resources such as expertise have been identified as a crucial factor in the organisation's innovation capacity (Damanpour, 1991; Grant, 1996). Through the integration of knowledge resources, new knowledge can be created (Grant, 1996; Nonaka & Takeuchi, 1995). The 'knowledge assets' or intellectual capital is the key resource for creating value (Edvinsson & Malone, 1997; Nonaka, et al., 2008, pp. 42-45). Davenport & Prusak (1998) stated this as following:

> "The intangibles that add value to most products and services are knowledge-based: technical know-how, product design, marketing presentation, understanding the customer, personal creativity and innovation." (Davenport & Prusak, 1998, p. 14)

This indicates that organisations require knowledge resources to exploit and explore opportunities for innovation (Tidd & Bessant, 2010). Similarly, Fischer (2006) stated that innovation and technology change is dependent upon the accumulation and development of relevant knowledge or wide variety. Furthermore, he emphasised that an organisation as a system of actors that creates and shares knowledge is the centre of its innovation capability (Fischer, 2006). Therefore, organisations require knowledge assets such as experts and knowledge resources to integrate by 'knowing-who' can create innovation. In addition to the management of information and knowledge resources, building an innovative organisation requires contexts such as vision and leadership (Tidd & Bessant, 2010).

### 2.6.3 *Vision and leadership practices*

Leaders contribute to transformational change and innovation by providing and communicating a vision for the organisation (Tidd & Bessant, 2010). Nonaka, et al. (2008, pp. 27-29) stated that the knowledge vision of a firm arises from the confrontation of the fundamental questions: 'why do we exists?', 'what do we want to be?' and 'why do we do what we do?'. This vision defines the kind of future that the company's leaders imagine for itself and provides direction and focus, which allows it to create knowledge beyond its existing products, capabilities and organisational structures and markets (Nonaka, et al., 2008, p. 27). Such a vision is just a set of empty words, if it does not have context and concrete mechanism to transform the vision into reality (Nonaka, et al., 2008, p. 29). Similarly, Andriopoulos (2001, p. 834) stated that the vision must be effectively communicated to be conducive to creativity. This creation and communication of the vision requires certain leadership practices.

Several leadership practices, characteristics and styles, which are cultivated within an organisation, have been investigated. Transformational leadership style with the characteristics of charismatic role modelling, individualised consideration, inspirational motivation and intellectual stimulation has been identified as conducive to creativity and innovation (Gumusluoglu & Ilsev, 2009). Furthermore, Mumford and colleagues discuss the leadership skills required to deal with and encourage change, which includes skills such as defining, understanding and creatively solving problems, social judgment for the refinement of solutions and social skills for motivating and directing individuals during solution implementation (Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000). There are several other practices which support creativity and innovation. Mumford, Scott, Gaddis, & Strange (2002) identified a total of forty two different propositions on how leaders can enhance creativity within an organisation such as clear framing of vision, concrete definition of missions and goals, dealing with diversity and complexity and supporting and motivating individuals.

Additionally, Amabile, Schatzel, Moneta, & Kramer (2004) identified that a supervisory work environment can have significant impact on subordinate creativity. Such practices as showing support, helping in stressful situations and keeping employees informed can have a positive effect, while checking on the status of work too often, non-constructive feedback and inadequate understanding of work has a negative impact (Amabile, et al., 2004). This links to the leadership practice of challenge and balancing time pressure (Amabile, et al., 2002). Amabile (1998) emphasised that leaders should give direction and challenge, but at the same time need to provide a high level of autonomy and empowerment, as too much time pressure prevents creativity. It is proposed that leaders should permit employees the time and space for task familiarisation and, through greater task involvement, encourage them to think creatively, suspend judgment and provide developmental feedback, which allows them to develop task-relevant, problem-solving and creative skills (Tierney, 2008, pp. 112-113). These cultivated and shared leadership practices, characteristics and styles facilitate creativity within interactions among individuals, similar to the cultivated and shared behaviour of the organisation.

### 2.6.4 *Organisational behaviour and climate*

Behaviour and climate from an organisational perspective is a shared phenomenon. Adopted or learned values and behaviours which are shared between the employees within the organisation build large scale social structures. The shared behaviour is adopted and shared through imitation (Maturana & Varela, 1992, pp. 181-201). Maturana & Varela (1992, pp. 181-201) stated that imitation allows going beyond the ontogeny of one individual. Within a fluid and constantly changing world, imitation of behaviour provides a transgenerational consistency. This phenomenon in organisations is often stated as organisational culture and climate (Schein, 2004). Organisational culture unites individuals into social structures, the social or normative glue that holds an organisation together, which are manifested in symbolic devices, rituals, stories, legends and specific language under which individuals operate (Smircich, 1983).

Organisational behaviour or cultural element has been identified as influential to creativity among individuals and in teams (Andriopoulos, 2001). Vital elements of a shared social structure to facilitate creativity are an open flow of communication, risk-taking, behaviour that encourages self-initiated activities, sense of ownership, self-control over work and trust (Andriopoulos, 2001; Andriopoulos & Dawson, 2009, pp. 251-277). In contrast a mere-exposure effect and high confirmatory within the social structures can prevent creativity (Andriopoulos, 2001, p. 836; Andriopoulos & Dawson, 2009, pp. 258-260). This is similar to a low level of redundancy within a system. In addition, cultivated behaviour of participative, informal, interdisciplinary interactions, willingness and flexibility towards change and openness to proposals from others is conducive to innovation (Pervaiz, 1998). These behaviours are based on values and beliefs such as appreciation of trust, challenge, freedom, risk-taking, openness, future and external orientation, unity and commitment (Pervaiz, 1998).

The role of trust has been investigated by Ellonen, Blomqvist, & Puumalainen (2008). They identified that the trust in the organisation (institutional trust) of employees correlates positively with different innovativeness. In addition to institutional trust, product innovativeness requires a high level of trust in the competence of employees, while strategic innovativeness requires trust in the competence of leaders (Ellonen, et al., 2008, p. 172). Others have seen trust as part of work group support to stimulate free and open communication (Amabile, et al., 1996). This trust is the underlying dimension of social interactions that stimulate creativity and innovation. Furthermore, the positive effect of challenge and encouragement within organisations has been identified by Amabile, et al. (1996). In contrast pressure, such as a high work load, influences creativity negatively (Amabile, et al., 1996). High work load causes little room for exploration of new ideas. Similarly, social structure that facilitates autonomy and freedom is conducive to creativity (Amabile, et al., 1996). Autonomy establishes an environment in which intrinsic motivation can occur (Amabile & Kramer, 2011; Pink, 2009). Oldham & Cummings (1996) argued that individuals within an environment that provides freedom from extraneous concerns are likely to take risks, explore new cognitive pathways, be playful with ideas and are likely to stay focused on the initial nature of the task as well as work longer on an idea or problem. They found that creativity is high in a non-controlling and supportive environment with high job complexity and creative-relevant personal characters (Oldham & Cummings, 1996). Furthermore, a supportive environment is crucial for shifting from individual creativity to collective creativity. Hargadon & Bechky (2006) identified that four interrelating activities, namely, seeking help, giving help, reflective reframing and reinforcing, trigger collective creativity. Help provided by individuals and mindful behaviour such as respect both increase the ability of the person seeking help to solve his/her problem creatively (Hargadon & Bechky, 2006).

The challenge in organisation is to balance creativity and efficiency. Leavy (2005) stated that organisations need the right balance between play and discipline, practice and process and creativity and efficiency. Therefore, creativity and innovation rely on the collective ability to shift from play and creativity to discipline and efficiency. As discussed, certain social structures (cultivated values and behaviours) facilitates creativity within individual interactions and allow innovation to emerge within organisations. In addition to social structures, regulatory or organisational structures influence creativity and innovation.

### 2.6.5 *Organisational structure and workplace*

The physical, regulatory or organisational structures of an organisation can prevent and facilitate creativity. Quinn (1992, pp. 120-126), for example, argues that organisational structures such as interconnected or networked structures with little formal authority and in which individual units can operate independently facilitates knowledge creation and innovation. Similarly, Brand (1998), stated that flat and flexible organisational structures facilitate self-organisation and therefore adaptive and learning behaviour. This self-organisation allows the building of communities of practice (CoPs), which are linked to the generation of breakthrough innovations (Delemarle & Larèdo, 2008). The effects of social network structures have been investigated by Perry-Smith (2002, 2006, 2008) and Perry-Smith & Shalley (2003). Structures within a network that allow many weak ties and ties with individuals outside the organisation facilitate creativity (Perry-Smith & Shalley, 2003). It is interesting that the network structure is not stable, but continuously in motion, which generates a self-reinforcing spiral (Perry-Smith & Shalley, 2003, pp. 99-101). A creative person establishes a central position within the network and establishes strong ties, which lead at a certain point to his/her creativity decreasing (Perry-Smith

& Shalley, 2003). Therefore, a regulatory and organisational structure requires stimulating individuals to establish new weak ties and break with established strong ones.

Another important topic for the design and structure of the organisation is the dilemma of exploitation (use and development of what is known) and exploration (re-orientation that enables a firm to adopt new attributes and attain new knowledge outside its domain) (for example Christensen, 1997; March, 1991; Tidd & Bessant, 2010). A structure of exploration can prevent exploration and vice versa. To overcome this dilemma, an organisation requires a dual structure and strategies through structural ambidexterity as discussed by O'Reilly & Tushman (2004; 2007) and Tushman & O'Reilly (2006) or requires individuals to balance exploitation and exploration through contextual ambidexterity as introduced by Gibson & Birkinshaw (2004). Contextual ambidexterity is supported in less formal or regulated systems and individuals make their own choice on how to divide their time between alignment (exploitation) and adaptability (exploration) (Gibson & Birkinshaw, 2004, p. 221). This supportive context creates the capacity for ambidexterity. Similarly, Delemarle & Larèdo (2008, p. 191) state that spaces of rational proximity make it possible to move away from the 'ambidextrous organisation' and promote radical innovation. The generic mechanisms that allow new CoPs to emerge, which can be seen as one spatial form of knowing through communities, provide conditions which enable various members in different configurations (exploitation and exploration) to absorb and produce knowledge (Delemarle & Larèdo, 2008, pp. 191-195). The production of such spaces of exploitation and exploration are facilitated by self-organising structures rather than functional and hieratical structures.

Furthermore, Woodman, et al. (1993, p. 296) consider the physical environment as a contextual influence on creativity. Oldham (2003, pp. 252-253) states that physical configurations of workplaces, which establish spaces of low density and low presence of noise with adequate space can facilitate creativity. Similarly, Haner (2005) discusses the spatial support of creativity and innovation processes of both the individual and team. He identified that open workspaces (action zone) and cocoon-like workspaces (retreat zone) can support divergent thinking, while a workspace with smart furniture for more co-ordinated interaction supports convergent thinking. Furthermore, physical spaces such as coffeehouses are spaces in which individuals share ideas (Johnson, 2010, p. 64). Johnson (2010, p. 162; 166) emphasises that physical spaces such as coffeehouses facilitated enlightenment-era innovations. Also, Magadley & Birdi (2009) identified specifically designed workplaces, or so-called innovation labs, which can enhance organisational creativity. Innovation labs enhance, both at the individual and group level, the creation of useful and novel ideas (Magadley & Birdi, 2009). Similar to Oldham (2003, pp. 252-253), Magadley & Birdi (2009) identified that distractions in the workplace trigger work patterns, which are unfavourable for creativity. West (2002b, p. 379) argues that groups therefore should get away from their usual workplace and work in a pleasant and relaxing environment. This leads to the next factor in the complex organisational system: availability of resources such as time and budget.

### 2.6.6 *Resources*

Sufficient resources relevant for tasks have been identified as crucial for creativity and innovation. Amabile, et al. (1996) and Amabile (1998) identified that the two resources required for a creative performance are financial resources and time. The effects of inadequate resources can result in that employees are occupied with finding additional resources (Amabile, 1998). Furthermore, Amabile & Gryskiewicz (1987) cited in Shalley & Gilson (2004, pp. 39-40) identified time to think, explore different perspectives and play with ideas as important for creativity. More recently Amabile, et al. (2002) investigated time pressure in a longitudinal study, which identified that time pressure has negative impacts on creative cognitive processes. Amabile, et al. (2002) suggested that the relationship between time pressure and creativity may well be curvilinear, because it is entirely likely that creative ideas will not often be produced in the complete absence of any time pressure whatsoever, either self-imposed or externally-imposed. A further factor is sufficient information and knowledge resources as argued by Woodman, et al. (1993). Information and knowledge resources need to be accessed by individuals for pursuing creative activities (Shalley & Gilson, 2004, pp. 39-40). The information and knowledge resources were discussed in detail in section 2.6.1 and 2.6.2. Another factor relating to information and knowledge resources, which influence creativity and innovation, are communication and infrastructure.

### 2.6.7 *Infrastructure and communication*

Information and knowledge creation and exchange within organisations is executed through communication between individuals and the use of information technology infrastructure. Shared context within an organisation is created through the SECI model in which individuals create new knowledge though interacting with the environment and between individuals and share this knowledge in groups and through information technology (Nonaka & Takeuchi, 1995; Nonaka, et al., 2008, pp. 18-26; 193-195). For example, systematic collection and sharing via information systems enables feedback and identifies unprofitable products and causes at each stage in the value chain (Nonaka, et al., 2008, pp. 193-195). Therefore, infrastructures are needed for identifying, communicating and sharing problems, which are prerequisites for creative problem solving. These information technologies can also support the combination of information within the capacity of organisational creativity (Lee & Choi, 2003). An infrastructure that allows high amounts of data to be captured can lead to information overload, which is associated with feelings of inability to cope and inadequacy of knowledge and has been identified as a source of stress (Sparrow, 1999). Similar individual interactions can lead to information overload as stressed by Sparrow (1999), as well as to creativity.

Individuals communicate and interact within formal (related to goals and rules) and informal (conversations and storytelling) communication (Eisenberg, 1984). Informal communication is considered as a major organisational factor for group creativity (for example Sundgren, Dimenas, Gustafsson, & Selart, 2005). On the other hand, formal communications provide statements of current belief, newly discovered information, personal experience, or suggestions for successful completion of tasks (Weedman, 1992). Rather than questioning either or, Kratzer, Gemünden, & Lettl (2008) examined and identified that the misalignments of informal and formal communication networks decreases the creativity within those networks. These communication channels within an organisation influence the capacity of organisational creativity and innovation. Similar to organisational communication, different knowledge creating routines have been discussed in relation to innovation.

### 2.6.8 *Knowledge creation routines*

The theory of knowledge creation within an organisation is based on the SECI-model by Nonaka & Takeuchi (1995). This has been discussed in detail in section 2.2.3 (page 35). The SECI-model illustrates that certain cultivated routines lead to organisational knowledge creation. For the facilitation of creativity these institutionalised or cultivated knowledge creation routines such as use of information systems, face-to-face conversations and putting oneself in the space in which the phenomenon occurs can be conducive to creativity and innovation. This leads to the next question: Can creativity, similar to knowledge creation, be cultivated or enforced by certain institutionalised or cultivated routines and practices?

### 2.6.9 *Creative practices and routines*

Managing creativity is seen as managing the unmanageable, because, by its very nature, creativity is something different from what has been done before (Amabile, 1996b). Managers cannot direct creativity by telling employees exactly what they should do to produce a novel and useful result (Amabile, 1996b). Similarly, it is argued that the best management is sometimes no management, to enable creativity (Sutton, 2007, pp. 80-83; 179-181). Gilson, Mathieu, Shalley, & Ruddy (2005) identified that work standards and routines have a negative effect on team creativity. They stated that

> "teams and, ultimately, organisations face an interesting dilemma in that they need to strike a balance between being creative and employing standardised work practices." (Gilson, et al., 2005, p. 527)

Therefore, organisations need to consider alternative approaches to encourage both creativity and standardised work procedures. Kondo (1995, 2000) stated that standardisation, as rules which people have to obey, reduces the degree of freedom and therefore creativity. Creativity can be supported as means and methods, it can be the basic training manual or important references for carrying out a creative performance (Kondo, 1995, 2000). Similarly, Gilson, et al. (2005, p. 528) stated that an option is to train employees and combine creative processes with lower standardisation. This indicates that certain cultivated practices and routines such as diverse team formation and expression of opinions can facilitate creativity.

Therefore, the innovation capacity of an organisation is a dynamic capability rather than a static, and one which needs to be built and developed and cannot be bought (Teece, 2009).

### 2.6.10 *Conclusion on organisational innovation capability*

The section indicated nine different categories and their factors. These organisational capability including information and knowledge resources, leadership practices and shared behaviour, structure, communication and routines can facilitate creativity and innovation. The review identified that innovation can be supported by cultivating certain behaviour and practices and building a certain organisational structure. This innovation capability cannot be bought and therefore needs to be built and developed (Teece, 2009). Innovation cannot be established by a centralised structure or standardised practices as it requires a dynamic capability (Teece, 2009). It evolves and emerges in relation to the challenge to accomplish a creative and innovative outcome. Therefore, creativity and innovation require not only a structure that facilitates it. It requires also dynamic group processes creative individuals. These multi-level and multi-factor complexity and dynamic build a componential model of the organisation of knowledge, creativity and innovation.

## 2.7 Contextual framework of the organisation of knowledge, creativity and innovation

The integration of the individual and group creativity (micro level) (as discussed in section 2.4 on page 48 and section 2.5 on page 53) and the organisational capability (macro level) (as discussed in section 2.6 on page 58) build a framework of multi-level and multiple-factors of creativity and innovation as presented in Figure 2-8.

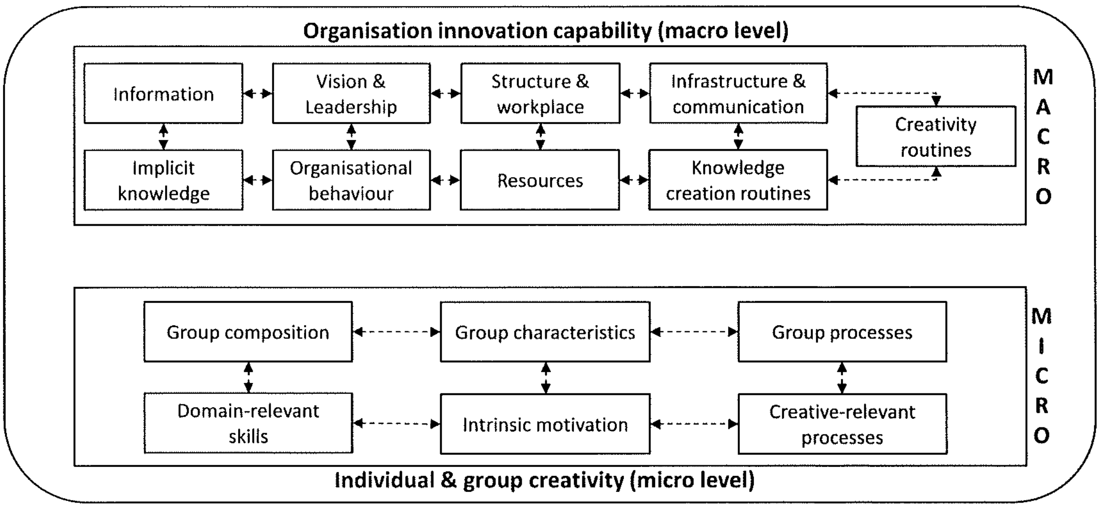



**Figure 2-8: Contextual framework of the organisation of knowledge, creativity and innovation**

This model illustrates the several components discussed in this chapter of the multiple-levels. These multiple influences and their interrelations need to be taken into account. A separate analysis of the each level and their inherent interrelating factors cannot explain the interactions between the multiple levels and the dynamic and emergent characteristic of creativity and innovation. Therefore, to investigate the organisation of knowledge, creativity and innovation, it is necessary to rethink current mainstream approaches and theories.

## 2.8 Conclusion

This chapter has reviewed the existing approaches of organisation of knowledge, creativity and innovation. It provided a discussion of different approaches and the need to investigate the multiple factors and level complexity inherent in organisations. Knowledge creation, creativity and innovation are inseparable and closely linked phenomena. Individual and team knowledge creation and creativity (micro level) are determined by the shared understanding (mental), behaviour (social) and rules and processes (contextual) of the organisation (macro level). For the understanding of the complex and dynamic phenomenon of creativity and innovation in an organisation a new perspective is required that takes into account the interrelation of the multiple factors and levels. This will be discussed in detail in the next chapter.

# Chapter 3 Autopoietic system perspective of the organisation of knowledge, creativity and innovation

*"We cannot think first and act afterward. From the moment of birth we are immersed in action, and can only fitfully guide it by taking thought."*
*Sir Alfred North Whitehead* (1938, p. 217)

***Keywords***

Rethinking organisational research · System theory · Autopoiesis · Cognition and autopoiesis · Social autopoiesis · Autopoietic organisation theory · Production of space · Pattern language · Autopoietic organisation of knowledge, creativity and innovation ·

## 3.1 Introduction

This chapter discusses autopoietic system theory in relation to the organisation of knowledge, creativity and innovation. The chapter is organised in six sections.

1. The chapter begins by discussing the different perspectives of organisational research. This includes the perspective of the organisation as an entity (absolute view), as a fluid process (process view) and as a self-producing system (autopoiesis). The purpose of this section is to examine different views of organisational research in relation to creativity and innovation in organisations.

2. The view taken in this research is the self-producing system view, which links to the autopoietic system theory. The self-reproducing view allows linking 'the organisation' as an entity and 'organising' as a fluid process. The basic functions of the autopoietic system theory are discussed in this section.

3. In this section an overview of the autopoietic system theory is provided. Autopoiesis has been used in several domains. The domains relevant in this research are (1) autopoiesis and cognition, (2) social autopoiesis and (3) autopoietic organisation theory. These different theories are discussed to provide theoretical grounding of the research. Furthermore, the autopoietic organisational theory is linked to the theory of space as advocated by Hernes (2003, 2004a).

4. Space permits the investigation and discussion of the mechanisms that produce system boundaries (space) as an entity itself. This section discusses different types of space, namely physical, virtual, regulatory (organisational system), mental (cognitive system) and social (social system) space. These different types of space interact with each other and produce system unity or space. This system unity or space can facilitate or prevent creativity and innovation to emerge.

5. Spaces as system states can prevent or enable change to occur. Change within systems emerges not continuously, but in sudden, discontinuous leaps. The fifth section argues that change includes both endogenous and exogenous influences and discusses four different system states relating to change within human and natural systems. This change is embedded in a complexity of multiple systems at different levels. The fifth section ends with the consideration that change can be facilitated

and prevented from within (for example lower system level) and from outside (for example higher or same system level) the system.

7. The last section summarises the complexity of the organisation of knowledge, creativity and innovation in relation to autopoietic system theory, theory of space and change in systems. This includes linking the cognitive (mental space), social (social space) and organisational system (physical, virtual and regulatory space), multiple-level interactions, investigation of the local context and large organisational context through a pattern language, dynamic capability and emergent phenomena through autopoietic reproduction, and different spaces for different system states such as exploitation and exploration.

The chapter ends with the conclusion that the investigation of the organisation of knowledge, creativity and innovation requires the examination of the local context that produces different spaces (for example space of exploitation or exploration) and the large organisational context, which recursively interacts with the local spaces. This allows multiple-level and multiple factor complexity to be taken into account, examination of the dynamic capability and emergent phenomena and provides a new approach to co-innovation through different production of spaces.

## 3.2 Rethinking the investigation of the organisation of knowledge, creativity and innovation

Organisations have been viewed from different perspective. There are two ways of understanding the world and organisations: "one side makes process ultimate; the other side makes fact ultimate" (Whitehead, 1978, pp. 6-7). The (1) 'fact view' or 'absolute view' is based on the Western tradition, while the (2) 'process view' is based on the Eastern tradition of philosophy (Whitehead, 1978, pp. 6-7). This debate between the two views is the question of entity versus flow. The absolute view sees the world as 'actual entities', which are drops of experience, complex and interdependent (Whitehead, 1978, p. 18). The process view dismisses the idea that things are passive entities and sees the world as in constant flow, as life is an ongoing process of events (Bakken & Hernes, 2006). The problem with either the 'absolute view' or 'process view' is that each is an important aspect of the understanding of the world (Bakken & Hernes, 2006). Bakken & Hernes (2006, p. 1602) point out, Whitehead emphasised that entities emerge from processes and enter into processes in turn. This recursive interaction of 'entity' and 'process' leads to a third view, which is based on the concept of 'self-production' (autopoiesis) (Bakken & Hernes, 2006; Hernes, 2004b, 2007; Hernes & Bakken, 2003). This section discusses the different views in relation to the research of creativity and innovation in organisations.

### 3.2.1 *The absolute view of organisation*

The first view is the (1) 'absolute view'. This represents mainstream organisational theory. Organisations are assumed as being concrete entities and are perceived as 'the organisation' (Hernes, 2007, p. 9). They are seen as monolithic or pre-existing entities, or both (Hernes, 2004a, p. 8). The organisation consists of organisational arrangements such as formal structure and manifested organisational culture. A process, in the absolute view, occurs within interaction of organisational goals and structures (Hernes, 2007, p. 19). The organisation as a system is considered as a concrete input-transformation-output system. This view of organisation focuses on the outcome of change rather than the process of change (Chia, 1999, p. 215).

Traditional organisational theory views the organisation as an open system in constant interaction with its context, transforming inputs into outputs as a means of creating the conditions necessary for survival (Morgan, 2006, p. 243). This open system approach is based on the general system theory of Bertalanffy (1969). This "dynamic non-equilibrium system theory", focuses on the mechanism of how a system maintains itself despite the fluctuations within the environment (Iba, 2010, p. 6614).

Structuralist studies (structuralism) identify structures (organisational and social architectures) that facilitate knowledge creation, creativity and innovation (as discussed in section 2.6 on page 58). The problem with the concepts of static structures is the nature of creativity and innovation. The nature of creativity and innovation is complex, dynamic and an emergent phenomenon (for example Iba, 2010; Sawyer, 1999, 2000; Teece, 2009). Therefore, structuralist approaches cannot explain the emergent dynamics of creativity and innovation.

### 3.2.2 *The process view of organisation*

In contrast, the (2) 'process view' treats organisation as constituted by processes (Hernes, 2007, p. 19). Therefore, organisation is defined as 'organising' (Hernes, 2004a, pp. 1-13; 26-29). Organisation should not be seen as an entity, but rather a process of combined events (Hernes, 2007, pp. 19-24). Order or structure within the flow is constituted by relatively stable patterns of behaviour that repeat themselves, which change relatively slowly (March & Simon, 1958, p. 170). Weick (1974) stated this 'process view' of organisation as follows:

> "The word organisation, is a noun and is also a myth. If one looks for an organisation one will not find it. What will be found is that there are events, linked together, that transpire within concrete walls and these sequences, their pathways, their timing, are the forms we erroneously make into substances when we talk about an organisation. [...] Just as a skin is a misleading boundary making off where man ends and the environment starts, so are the walls of an organisation. Events inside organisations and organisms are locked into circuits that extend beyond these artificial boundaries." (Weick, 1974, p. 358)

From this point of view, 'organising' requires constant sensemaking and action of the fluid world (Weick, 1995). In the 'process view' change must not be thought of as a property of organisation, but rather organisation must be understood as an emergent property of change (Tsoukas & Chia, 2002). Creativity and innovation as a contingent process have been investigated and identified by scholars such as March (1981, 1991), Lubart (2001), Nonaka, et al. (2008) and Sawyer (2007). Several studies of creativity as a process have been discussed by Shalley & Zhou (2008).

The second generation of system theory according to Iba (2010, p. 6614) is the "dynamic equilibrium system theory". Its key concept is self-organisation. "Dynamic equilibrium systems" relate to "complex system theory". Mitchell (2009, p. 13) stated that a system which exhibits nontrivial emergent and self-organising behaviour is a complex system. The self-organising behaviour arises without an internal or external controller and simple rules can result in complex behaviour (Mitchell, 2009, p. 13). This complex behaviour on the macroscopic level of such a system can be called emergent (Mitchell, 2009, p. 13). The "complex system theory" focuses on the mechanism of how a structure of system is crystallised from disorder (Iba, 2010, p. 6614). This system theory relates to the 'process view'.

Interactionist and phenomenologist studies examine the situation and momentary events within interactions of individuals in which knowledge, creativity and innovation occurs (as discussed in section 2.4 on page 48 and section 2.5 on page 53). The studies provide insight into how structure emerges from disorder and how knowledge, creativity and innovation come into being. The problem with this view is that it does not explain how the existing system structure (established memes, ideas technology, resources) influences the process of creativity and innovation.

### 3.2.3 *The self-reproducing view of organisation*

The distinction between 'the organisation' as an entity ('absolute view') and 'organising' as a constant flow ('process view') is not satisfactory as it leaves no room between the levels of process (action) and structure (form) (Hernes, 2004a, pp. 8-17). Langley & Tsoukas (2010, p. 3) stated that long-established dualisms such as mind and body, individual and collective, agency and structure need to be overcome. One should rather focus on the interaction of 'organising' (process) and 'organisation' (structure). This relates to the questions of "how entities come into being through process, and how they enter into process in turn" (Hernes, 2007, p. 29).

'The organisation' and 'organising' should not be seen as separate phenomena, but rather as a recursively interacting phenomenon (Hernes, 2004a, pp. 30-40). Maturana & Varela (1980, 1992) identified in biology and cognition that 'structure' (entity) and 'organisation' (process) are not separate but rather different aspects of unitary phenomenon; a dichotomy. The dynamics or organisations (process) produce the boundaries and structure (entity) and the boundary and structure (entity) is essential for the operation of the organisation (process) (Maturana & Varela, 1992, p. 46). These are not sequential processes, but two different aspects of the same phenomenon (Maturana & Varela, 1992, p. 46). The basic principle of the self-production, namely the recursive interaction of structure and process, is presented in Figure 3-1.

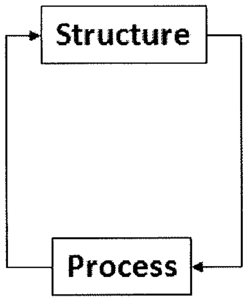



**Figure 3-1: Self-reproduction through recursive interaction of structure and process (Maturana & Varela, 1980, 1992)**

This self-reproduction of a system through entity and process is termed autopoiesis. This is the third system theory, the "self-production system theory" with its main concept of autopoiesis (Iba, 2010, p. 6614). Autopoietic system theory focuses on the mechanism of how a system itself is realised over time (Iba, 2010, p. 6614). This principle of self-reproduction (autopoiesis) has been developed and investigated for social systems by Luhmann (1995, 2003, 2009), Giddens (1979, 1981, 1984) and Fuchs (2002, 2003; Fuchs & Hofkirchner, 2009). Based on the social self-producing system theory, organisation from a 'self-producing view' has been investigated by several scholars such as Bakken & Hernes (2003a), Hernes (2004a, 2007) and Magalhães & Sanchez (2009a). The self-producing view of organisation incorporates the recursive interaction of 'the organisation' (structure) and 'organising' (process). In this self-production 'the organisation' is constituted by 'organising' and 'organising' is determined by 'the organisation' (for example Bakken & Hernes, 2003a, 2006; Fuchs, 2003; Hernes, 2004b). From this perspective, innovation can be considered as a function of redundancy (Bakken, et al., 2009a, 2009b). The self-reproducing view allows investigating both the structure ('the organisation') and the process ('organising') that facilitate or hinder creativity and innovation.

### 3.2.4 *Conclusion on rethinking the organisation of knowledge, creativity and innovation*

This discussion of the different views in relation to the investigation of creativity and innovation indicates that the third-view is required to examine the dynamic and emergent capability of creativity and innovation in organisations. This 'self-producing view' (autopoiesis) permits researchers to examine how structure constrains or enables individual interactions (individual and group creativity) and how individual interactions produce the structure (organisational innovation capability). This allows investigating the interactions between the organisational innovation capability (macro level) and individual and group creativity (micro level) (as discussed in Chapter 2) and its dynamic and emergent nature within the organisation as an autopoietic system.

## 3.3 Autopoiesis – living and self-producing system

The self-reproducing view is based on the theory of autopoiesis. Autopoiesis comes from two Greek words: 'αὐτο-' (self) and 'ποίησις' (creation or production) and was developed by Maturana & Varela (1980, first published in 1972). Autopoiesis was developed in biology and cognition (Maturana & Varela, 1980, 1992) and has been developed in sociology (Fuchs, 2003; Luhmann, 1995) and organisational and management theory (Bakken & Hernes, 2003a; Magalhães & Sanchez, 2009a).

Maturana & Varela (1980, pp. 78-79) defined an autopoietic system as following:

> "An autopoietic machine [system] is a machine [system] organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network." (Maturana & Varela, 1980, pp. 78-79)

In other words, an autopoietic system is a self-reproducing system due to its structure (and boundary) and organisation, and an autonomous unit (operationally closed) and open system due to its structural coupling. This section discusses briefly the general functions of the autopoietic system theory.

### 3.3.1 *Structure and organisation (self-reproduction)*

The autopoietic system produces itself through the mechanisms of structure and organisation (Maturana & Varela, 1980, p. xix). According to Magalhães & Sanchez (2009b, p. 5), organisation means a necessary network of rules that governs relations between system components and which thereby defines the system conceptually. In the autopoiesis, structure is the actual relations between the components that integrate the system in practice. This structure satisfies the constraints imposed by the organisation. Maturana & Varela (1992, p. 47) state that the structure denotes the components and relations that actually constitutes a particular unity and makes its organisation real. This structure is the tangible manifestation of the relationships and describes how the relationships appear in phenomena (Brocklesby, 2009, p. 32). The producing process of the system itself is presented in Figure 3-2.

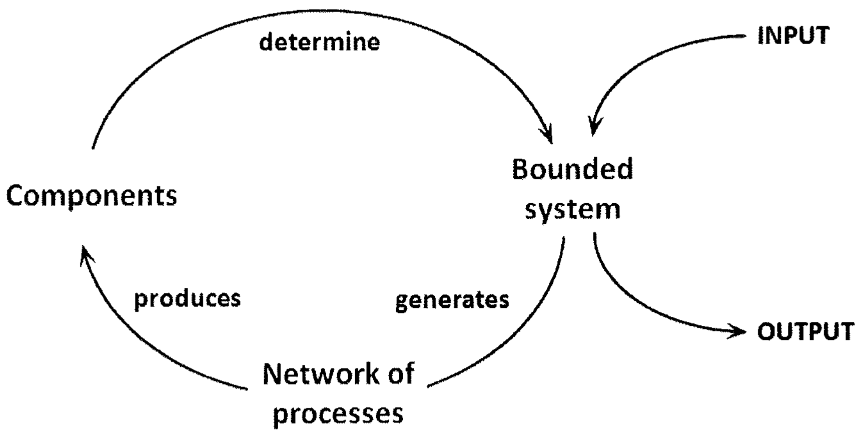



**Figure 3-2: Basic autopoiesis process of self-reproduction. Adopted from Luisi (2003)**

Figure 3-2 shows that the system structure generates the network of processes, which produce the components, which then determine the structure (bounded system). This process allows the system to reproduce itself. For the structure to manifest itself and in order to enable the evolution of the structure through recursive organisation, the autopoietic system needs to be autonomous unities (Magalhães & Sanchez, 2009b, p. 6).

### 3.3.2 *Autonomous unities (operationally closure)*

Autopoietic systems are autonomous unities. Autonomous unities are operationally closed This means that firstly, the system produces its own boundary and secondly, within its boundaries it can specify its own laws (Maturana & Varela, 1992, pp. 46-49). Autopoietic systems are not a set of inputs and outputs, but an internal coherence that results from the interconnectedness of a system's inputs and outputs (Magalhães & Sanchez, 2009b, p. 6). In other words, the autopoietic system is a closed system. However at the same time it is open because it interacts with other systems and the environment within time and space through 'structural coupling'.

### 3.3.3 *Structural coupling*

The autopoietic system realises itself through a particular structure and the changes it can undergo are determined by this structure as long as self-reproduction is maintained (Mingers, 1995, p. 35). This implies that the system cannot be directly determined by its environment. Nevertheless, autopoietic units can interact with other systems and their environments, by which structural change can occur within the system through the interaction (Maturana & Varela, 1980, pp. xx-xxi; 1992, pp. 74-75; 180-201). The only way to overcome the operational closure is through structural coupling. The structural coupling is illustrated in Figure 3-3.

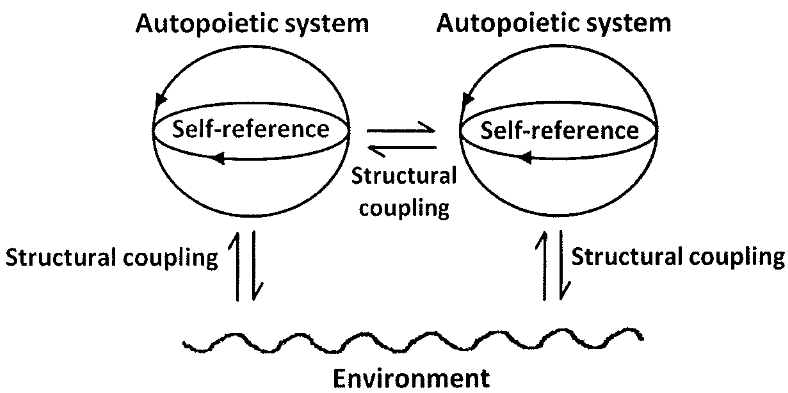



**Figure 3-3: Structural coupling of autopoietic systems and the environment. (1992)**

As illustrated in Figure 3-3, when two autopoietic systems interact through structural coupling, structure-determined changes can occur in both systems. Brocklesby (2009, p. 33) stated that each system structure changes congruently, each one according to its own structural determinism. This means that there is no direct cause and effect within the structural coupling of autopoietic systems. The operation of the self-reference and structural coupling simultaneously allows infinite diversity of structures to occur, because each system creates its own structure through its own structural determinism. Change in the system occurs when interactions create a change in the structure through its own operation within the system. This change is only preserved when the structural change alters the operations of the reproduction and the system can change its class identity (Maturana & Varela, 1980, pp. xix-xx; 1992, p. 47). The change is lost if the organisation has not integrated the change and the system reproduces itself according to its previous operation. This is relevant for the understanding of creativity and innovation in an autopoietic system. When a novelty is introduced into a system, and the system integrates this novelty into its operation, it preserves the novelty and reproduces it. This novelty can be seen as adopted by the system and is therefore an innovation.

### 3.3.4 *Conclusion to autopoietic system theory*

The overview of the autopoietic system theory indicates that the autopoietic system has the characteristics of a self-reproducing and autonomous unit, which interacts with its environment and other system through structural coupling. The autopoietic system theory has been investigated and applied in several different domains.

## 3.4 Autopoietic systems

Autopoietic system theory has been applies and developed in several fields. Autopoiesis in biology and cognition has been developed by Maturana & Varela (1980, 1992). Autopoiesis has been applied and developed for human systems and social theory. This social autopoiesis theory has been developed by several scholars such as Luhmann (1986, 1995, 2003, 2009) and Fuchs (2002, 2003, 2008; Fuchs & Hofkirchner, 2009). Similar to social autopoiesis, Giddens (1979, 1981, 1984) has developed the theory of structuration, in which society reproduces itself. An overview of social autopoiesis has been discussed by Mingers (1995, 2002, 2004).

The social autopoiesis in organisations has been investigated by scholars such as Beer (1984, 1985), Bakken & Hernes (2003a), Hernes (2004a, 2007), Maula (2006), Magalhães & Sanchez (2009a) and Zeleny (2004, 2006). An overview of different autopoietic systems is presented in Figure 3-4.

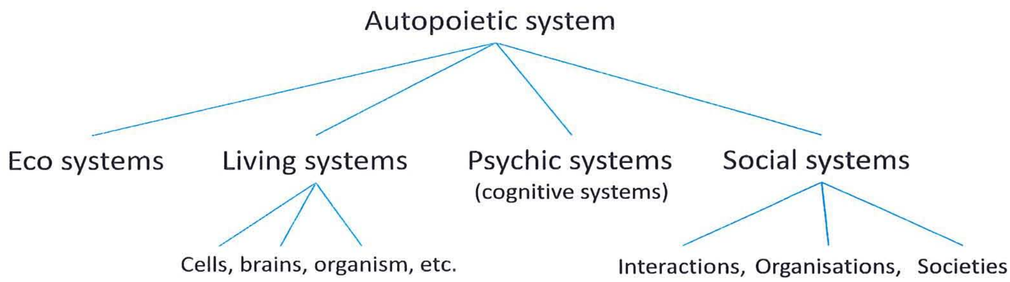



**Figure 3-4: An overview of autopoietic systems. Adopted from Iba (2010, p. 6623); Originally based on Luhmann's (1995, p. 2) systems diagram**

More recently scholars started to investigate creativity and innovation from an autopoietic system theory (Bakken, et al., 2009a, 2009b; Iba, 2010, 2011). The organisation of knowledge, creativity and innovation incorporates the autopoietic systems of cognition (knowledge creation, thought collectives and creation of creative discoveries), social autopoiesis (communication, interaction and social structures) and organisational autopoietic theory (regulations and organisational structures). This section discusses the cognitive, social and organisational theory of autopoiesis.

### 3.4.1 *Autopoiesis, cognition and knowledge creation*

The theory of cognition and autopoiesis has been developed by Maturana & Varela (1980, 1992). It is a constructivist approach. In this approach the mind and knowledge is embodied in individuals (Varela, Thompson, & Rosch, 1991) and knowing is related to adequate doing. Maturana & Varela (1980, p. 53) state this as follows:

> "The question, 'What is the object of knowledge?' becomes meaningless. There is no object of knowledge. To know is to be able to operate adequately in an individual or cooperative situation." (Maturana & Varela, 1980, p. 53)

Therefore, "all doing is knowing and all knowing is doing" (Maturana & Varela, 1992, pp. 25-27). Knowledge is created through interaction with the environment (structural coupling) and processes through each individual's experience (self-reference). This "brings forth a world through a particular way of being and how the world appears to us" (Maturana & Varela, 1992, p. 26). A very basic example of this is the duck-rabbit test by Joseph Jastrow. This is ambiguous figure of either a duck or a rabbit as shown in Figure 3-5 (Kihlstrom, 2004; Wittgenstein, 2009, p. 204 [1953]).

**Figure 3-5: Duck-rabbit. Originally published in Fliegende Blätter ("Welche Tiere gleichen einander am meisten?," 1892)**

This illustrates that perception is a mental activity based on existing cognitive structures and not just a product of the stimulus (Bortoft, 1996, pp. 49-57; Kihlstrom, 2004). Process of cognition and autopoiesis is described in great detail by Maturana & Varela (1980), Varela & Shear (1999) and Varela (1999).

This autopoietic theory of cognition and knowledge creation is relevant for the study as it identifies that knowledge is creation by the system itself through structural coupling and self-reference. The knowledge creation is linked to action and interaction of individuals (structural coupling) and dependent one's existing cognitive framework (self-reference). Furthermore, collective knowledge creation is dependent on what Maturana & Varela (1992, pp. 234-235) call 'languaging. Through 'languaging' a linguistic domain or shared mental domain is created such as 'thought collectives'. The bridge between individualised knowledge and socialised knowledge is achieved by means of language (Von Krogh & Roos, 1995). It allows the creation of shared mental domains. These interaction of individuals also relate to social activities, which leads to the next autopoietic system theory; social autopoiesis.

### 3.4.2 *Social autopoiesis*

Theory of social autopoiesis has been investigated by several scholars such as Luhmann (1986, 1995, 2003, 2009), Giddens (1979, 1981, 1984) and Fuchs (2002, 2003, 2008; Fuchs & Hofkirchner, 2009). Social autopoietic systems establish and reproduce themselves through the structural coupling of entities such as individuals. A social system (structural coupled entities) reproduces its own structure through communication as discussed by Luhmann (1995) or through interaction between individuals as described by Giddens (1984, pp. 1-40) or Fuchs (2003). This section discusses briefly the social autopoietic theories. A detailed discussion can be found in Appendix B (page 358).

The most developed social autopoietic theory is Luhmann's (1986, 1995) social autopoiesis. This theory is based on the approach that social system use communication as their particular mode of reproduction (Luhmann, 1986, p. 174). This autopoietic self-reproduction results in temporary or momentary events of communication, which causes the system to be an emergence and self-reproducing phenomenon (Hernes & Bakken, 2003). The social system exists through its own production and reproduction. For example, communities exist only as long as its members continue to interact with each other. Such a community establishes certain rules of communication. The system is not bound to particular individuals. As Mingers (1995, p. 144) points out; individuals will come and go but communication dynamics will remain within the social system. Therefore, each social system has its own communication dynamics and communication between social systems can only be 'interpreted' by each system through its own self-reference. A system cannot receive information from the environment directly, but can interact with the interpretation of it. Hernes (2004a, p. 31) stated that a system should be seen as evolving from interactions with their own states, rather than conceive of systems to be reactive to an external environment. This indicates that the social system reproduces through the recursive interaction of its own structure and processes.

The social autopoiesis by Luhmann (1986, 1995) is joined by the structuration theory of Gidden (1984) in its focus on recursive and structure. This social theory incorporates the self-reproduction of the social system through the interaction between agency and structure (Giddens, 1984, pp. 1-40). The structure of the system is not the experience of the individual actors nor is it any form of social totality, it is the social practice ordered across time and space (Giddens, 1984, p. 2). Therefore, social structure is reproduced through the social interactions and activities of agents (individuals) across time and space. This theory of structuration incorporates several similarities to social autopoiesis as it deals with continual, recursive and (re)production of social structure through time.

Another social autopoietic theory was developed by Fuchs (Fuchs, 2003, 2004) and Fuchs & Hofkirchner (2009). This critical social autopoiesis combines the approaches of structuration and social autopoiesis with the concepts of self-organisation and emergence of the complex system theory (Fuchs, 2003). In this theory communication and social interactions are part of the structure that relates social groups and individuals and exists between individuals as a connecting mechanism (Fuchs, 2003). This social self-recreation of the system through the recursive interaction of social structure and individuals is illustrated in Figure 3-6.

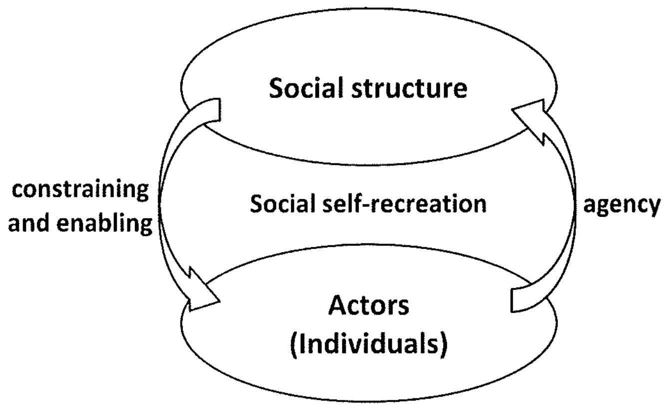



**Figure 3-6: Dialectic of socials structure and actors (social autopoiesis) (Fuchs, 2002, p. 41; 2003, p. 145; Fuchs & Hofkirchner, 2009, p. 122; Hofkirchner, 1998)**

According to Fuchs (2003, pp. 142-143), the global structures (macro level) emerge from local interactions (micro level) by circular causality. In this sense, the self-reference of the social system is based on the principle that society reproduces man as a social being and man produces society by socially coordinating human actions (Fuchs, 2003, p. 144). The individuals embedded in the social structure are constrained and enabled by this social structure as it influences an individual's actions and thinking (top-down process in Figure 3-6). On the other hand, through social interactions and communication new qualities and structures can emerge that cannot be reduced to the individual level (bottom-up process in Figure 3-6) (Fuchs, 2003, p. 144). This allows including the creative dimension as human beings are able to anticipate possible future states of the world and have the ability to create something new. In this sense, man designs society based on creativity as it allows going beyond facticity, creates visions of a desirable future (of society) and looks for a solution to existing (social) problems as discussed by Banathy (1996) cited in Fuchs (2003, p. 145).

These theories have in common the focus of the self-reproduction of the system and the desire to explain continuity and reproduction in time-space and focus on dynamics of evolving contexts for human actions and interactions. Based on the social autopoietic theories, the autopoietic organisation theory has been developed.

### 3.4.3 *Autopoietic organisation theory*

The autopoietic organisation theory has been investigated and discussed by scholars such as Luhmann (2000), Bakken & Hernes (2003a), Hernes (2004a, 2007) and Magalhães & Sanchez (2009a).

The self-reproduction of an organisation exists as a recursive interaction of the structure ('the organisation') and the interactions of individuals within the system ('organising') (Hernes, 2004a, pp. 1-40; Magalhães & Sanchez, 2009b, pp. 18-21). This self-production of the system is formed by the interactions of the macro level (the organisation, system structure) and micro level (organising, process, flow, interactions of individuals) (Bakken & Hernes, 2003b; Goldspink & Kay, 2009). For example, the budgets can be seen as the structure, while the budgeting is the process, which is influenced by the budget and vice versa. Autopoiesis allows a description of the generative processes (structure to process) and emergent structures (process to structure) (Goldspink & Kay, 2009, pp. 92-94).

The organisation as an autopoietic system self-produces its own context (Hernes, 2004a, pp. 41-58). Context relates to the continuity of action and interaction in time-space, which expands over time and space (Hernes, 2004a, pp. 43-46). The context can be viewed as (A) localised in time–space (group situations or momentary situations) and can be viewed in relation to the (B) organisation at large (for example organisational culture and structure) (Hernes, 2004a, pp. 46-48). The (A) localised contexts are momentary events and situations in which actors are co-present in time-space (for example Hernes, 2004a, 2007; Iba, 2010; Latour, 2005). These situations and momentary events reproduce themselves and can change depending on the action and interaction of co-present individuals within time and space. This fluid process or flow of momentary events within individual interactions bounded in time-space is exemplified in Figure 3-7.

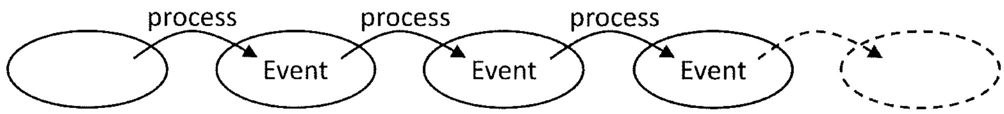



**Figure 3-7: Ongoing recursive interaction between event (structure) and process within individuals' interactions in time and space. Based on Hernes (2004a, 2007); Luhmann (1995); Latour (2005); Iba (2010)**

Creativity in the (A) localised context are the cognitive (psychic) and social interrelating influence factors that facilitate and trigger discoveries and sparks as described by Iba (2010, 2011). Within an organisation, contextual factors such as hierarchical position and job responsibility can influence the production of momentary events and situations as discussed in section 2.5 (page 53). This (A) localised context is formed by the context of the macro level, the (B) larger organisation context, while the (A) localised context builds the (B) organisational context in turn. The organisational context extends or exists over time and space (Hernes, 2004a, pp. 46-48). This is illustrated in Figure 3-8

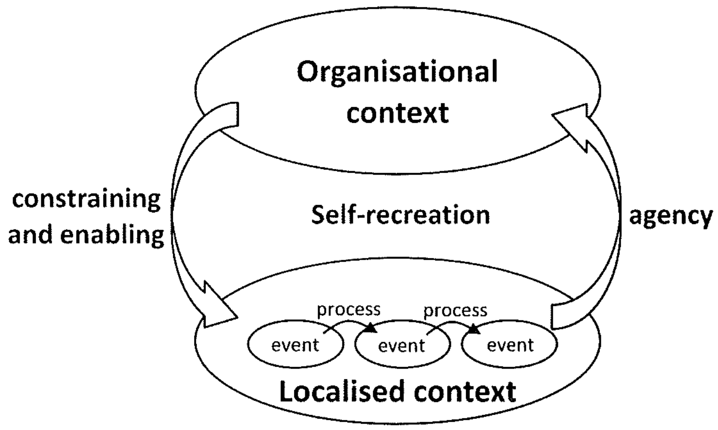



**Figure 3-8: Organisational autopoiesis – recursive interaction between large organisational context and localised context within individual interactions. Based on approaches and theories of Bakken & Hernes (2003b) Fuchs (2003); Hernes (2004a, 2007); (1999, 2005); Luhmann (1995, 2003);**

Figure 3-8 illustrates the organisational autopoiesis including the localised self-reproduction of context within individual interactions.

Several scholars have picked up the idea of self-referentiality within organisational theory such as Beer (1984, 1985), Maula (2006) and Nonaka & Takeuchi (1995). Beer (1984, 1985) developed the viable system model in which an organisation recursively interacts within its environment. Similarly, Maula (2006) argues that an organisation is a knowledge creation unit, which creates knowledge through a recursive interaction with the environment through boundary elements (sensing process) and establishes this knowledge throughout the organisation through the memory process (self-reference). Nonaka & Takeuchi (1995) uses the idea of a self-referential cycle (SECI-spiral) of organisational knowledge creation as discussed in section 2.3.3 on page 42. The self-referential process of knowledge creation from individual to group to organisation generates the organisational knowledge, which ultimately influences the knowledge creation of individuals within the organisation.

The autopoietic organisation theory provides a model of how organisational context is created through individual interactions and in turn organisational context determines (constrains and enables) local context within individual interactions.

### 3.4.4 *Conclusion on autopoietic systems*

The autopoietic systems of interest to this research are the cognitive autopoietic system of the individual (mind, mental or psychic system), the social autopoietic system of individual interactions, groups and collectives (social system) and the organisational autopoietic system that reproduces its own context (organisational system). These three different autopoietic systems allow investigation of the cognitive, social and contextual aspects of organisation of knowledge, creativity and innovation.

Mingers (1995, 2002, 2003, 2004) critically reflects the social and organisational autopoiesis and argues that the approach of social autopoiesis has several weaknesses, but through a combination with other theories could result in a fruitful theory of autopoiesis. Hernes (2004a, 2007), Fuchs (2003) and Fuchs & Hofkirchner (2009) pick up on this discussion. They use and combine Luhmann's (1986, 1995,

2003) social autopoiesis of communication, Giddens's (1984) duality of structure and structuration theory, Bhaskar's (1978) dialectic of structure and agency, Latour's (1999, 2005) idea of the network-actor theory, Weick's (1979, 1995) sensemaking and organising, and complex system theory as described by Hernes (2004a, 2007), Fuchs (2003) and Fuchs & Hofkirchner (2009). Another challenge stated by Mingers (1995, pp. 148-152; 2002, 2004) is the operational closure of the social system as it is difficult to identify the boundary of the social system. Based on the work of Lefebvre (1991 [1974]) and Spencer-Brown (2008 [1969]), Hernes (2003, 2004a, 2004b) discusses the boundary of the system from a spatial perspective.

## 3.5 Space as self-reproducing system

Space is together with time a fundamental category of human existence (Hernes, 2004a, p. 66). For philosophers such as Kant (1998 [1781]), Heidegger (1962 [1927]) and Nishida (1990 [1921]) stated space ('Raum', 'Ort' and 'basho') as essential for human experience. This space of existence is stated in several cultures. Nonaka, et al. (2008, p. 34) identified several concepts of space such as Nishida's 'basho' as a place of pure experience, Plato's 'chora' as a place of genius, Aristotle's 'topos' as a place of physical existence and Heidegger's '*Ort*' as a place of human existence. Lefebvre (1991) offers a profound discussion of the nature and production of space. Hernes (2004a) takes this idea of space and links it to firstly the autopoietic reproduction of systems and secondly to organisational theory. This section discusses the production, mechanism and boundaries of space and its relation to the organisational theory of knowledge, creativity and innovation.

### 3.5.1 *The production of space*

Spaces do not only exist in such a way that one can walk in and out, such as a room. They are produced mentally, socially and physically (Hernes, 2003, 2004a). Hernes (2004a, p. 67) points out that these spaces cannot be considered as absolute, but as mere production of processes within which seeds are sown for processes that create new spaces. The production of space was introduced by Lefebvre (1991). For Lefebvre, production is broader than the economic production of things and includes the production of society, knowledge and institutions (Elden, 2004, p. 184). Space in Lefebvre's (1991, pp. 84-85) account is produced by several forces and their elements such as nature, labour, technology and knowledge, structures (property relationships) and superstructures (institutions and the state itself). These forces and structures are the context that produces space. Context is not only linguistic but practical and social as one cannot situate or define a thing without the specifications of space and time (Elden, 2004, p. 183). The error is to consider things in isolation, as things themselves (Lefebvre, 1991, p. 89). Therefore space should be considered as space itself, as an entity in itself. Lefebvre (1991, p. 88) stated this as follows:

> "A comparable approach is called for today, an approach which would analyse not things in space but space itself, with a view to uncovering the social relationship embedded in it. The dominant tendency fragments space and cuts it up to pieces. It enumerates the things, the various objects, that space contains. Specialisations divides space among them and act upon its truncated parts, setting up mental barriers and practico-social frontiers." (Lefebvre, 1991, p. 88)

This examination of space relates to system thinking (Senge, 2006), for example, as things are not observed in isolation, but are investigated as a whole, as space.

According to Lefebvre (1991), the produced space, which exists in the moment ('Augenblick' = 'blink of an eye') is the place in which the past (history) and future (possibility) collide in the present moment (actuality) (Elden, 2004, p. 172). Hernes (2004a, p. 68) argues that this momentary event or space is not only produced, but continuously reproduced, which links the production of space to the self-reproduction (autopoiesis). Similarly, Iba (2010, pp. 6614-6615) states that momentary events are reproducing themselves through their operation. Each moment is different but is based on the moment before and produces the moment after. Spaces reproduce themselves as they function as an actuality, in the sense that it can be perceived on the one hand and on the other hand work as potentiality, in the sense that it leads to new actuality (Hernes, 2004a, p. 67). In this sense, space is both a process and product of context within and of an organisation; an autopoietic system (Hernes, 2004a, p. 67).

### 3.5.2 *Organisational theory and space*

Space allows us to connect the organisation theory with the self-reproducing system theory (autopoiesis) (Hernes, 2003). According to Hernes (2004a, p. 63) the idea of space serves as a way of explicating the interactions between spheres in which individuals find themselves and which influence their cognitions and interactions.

Space in relation to organisation and knowledge creation, creativity and innovation has been discussed by several scholars. Amin & Roberts (2008a) provide an overview of spatial mechanisms in relation to communities, situated knowing, creativity and innovation, Crang & Thrift (2000) discuss thinking spaces, Hernes (2004a, 2004b) provides a framework to investigate space in organisations, Nonaka and colleagues (Nonaka & Konno, 1998; Nonaka & Nishiguchi, 2001; Nonaka & Toyama, 2003; Nonaka, et al., 2008; Nonaka, von Krogh, & Voelpel, 2006) introduce space and organisational knowledge creation, Taylor & Spicer (2007) use space to investigate distance, power relations and experience in organisations and Thrift (2008a, 2008b) discusses space in relation to his concept of 'worlding' and 'non-representational theory'.

Nonaka & Konno (1998) introduced the concept of space, namely 'Ba' (Japanese for 'space', 'place' or 'field') as a shared context of knowledge creation. Nonaka, et al. (2008, p. 34) defined 'ba' (space) as the context for knowledge creation - an existing place where participants share contexts and create new meaning through interactions, which is a temporary container for creative interaction guided by a particular worldview that establishes the conditions for participation. When knowledge is disembodied from context (space) it becomes just information. 'Ba' can be also seen as a shared space for emerging relationships (Nonaka, et al., 2008, p. 34; Nonaka, et al., 2006, p. 1185). From the self-reproducing view, it is emergent in that sense that the 'process' produces new relationships and new spaces ('structure').

Space exists both locally as context of momentary events bounded in space-time and globally as a context of the larger organisation, which exceeds space and time (Hernes, 2003; 2004a, pp. 59-70). Nonaka, et al. (2008, pp. 133--135) refers to the local space as 'ba' (local context) and the organisational context as 'greater ba' (greater space). Local spaces are influenced by and embedded within the greater space. They also produce the greater space. This reproduction of local spaces ('organising', micro level) and greater space ('the organisation', macro level) refers to the autopoietic organisation theory as discussed in section 3.4.3 on page 86. These spaces are created through different mechanisms and produce their own boundaries.

### 3.5.3 *Mechanisms and boundaries of space*

Hernes (2004a, pp. 69-70; 2004b) stated that according to Lefebvre (1991) there are three different spaces, namely physical (space as a real entity), social (representational space) and mental (representations of space). Mechanisms that that produce a social space are for example social bonding. Social boundaries are largely given by the social bonding between individuals, which draw boundaries to other groups and incorporate social factors such as trust, identity and norms (Hernes, 2004b, p. 14). Thrift (2006, 2008b) stated that within a network (beyond the boundaries of a firm) different components such as mutual interest can build groups (communities of innovation), which stimulates passion, overcomes organisational boundaries and speeds up the process of production. These communities produce a new space based on mutual interest. Also categories such as social, technological and boundary objects provide an infrastructure for knowledge exchange (Hall, 2003; Hall & Graham, 2004). This infrastructure can build shared context through knowledge exchange and therefore can produce mental spaces. For further mechanisms of spatial production in relation to knowledge creation, creativity and innovation have been discussed by Amin & Roberts (2008a, 2008b), Crang & Thrift (2000) and Nonaka & Toyama (2005), Nonaka, et al. (2008, pp. 107-240) for example.

These mechanisms produce spaces as well as the boundaries of the system. Maturana & Varela (1980, p. 135) stated that the autopoietic organisation defines a space in which it can realise itself as a concrete system, a space whose dimensions are the relations of production of the components that realises it. This space builds the boundaries of a system. Hernes (2004a, pp. 70-124; 2004b) studied the boundaries within an organisation. He identifies three spaces, which are spatially distinct. This framework for studying boundaries is presented in Table 3-1.

| | **Mental boundaries** (relate to core ideas and concepts that are central and particular to the group or organisation) | **Social boundaries** (relate to identity and social bonding tying the group or organisation together) | **Physical boundaries** (relate to formal rules and physical structures regulating human action and interaction in the group or organisation) |
|---|---|---|---|
| **Ordering** The extent to which boundaries regulate internal interaction | To what extents are main ideas and concepts decisive for what members do? | To what extent do members feel that they are socially bonded together by something such as loyalty? | To what extent do formal rules or physical structures regulate the work of members? |
| **Distinction** The extent to which boundaries constitute a clear demarcation between the external and internal spheres | To what extent are main ideas and concepts distinctly different from those of other groups? | To what extent are we socially distinct from other groups? | To what extent does our formal structure set us apart from other groups or organisations? |
| **Threshold** The extent to which boundaries regulate flow or movement between the external and internal spheres | To what extent can outsiders assimilate core ideas and concepts? | To what extent is it possible for outsiders to be considered full members of the group? | To what extent do formal structures hinder the recruitment of outsiders? |

**Table 3-1: A framework for interpreting boundaries within an organisation (Hernes, 2004a, p. 81; 2004b, p. 13)**

### 3.5.4 *Physical, virtual & regulatory space – system boundary of the organisational system*

The first distinct space is the physical space (organisational system). This space incorporates three different types (Hernes, 2004a, p. 85). The first *physical space* in organisational theory is associated and made of tangible entities such as material barriers, which defines the limits of movement and access (Hernes, 2004a, p. 85). The second space associated with physical space according to Hernes (2004a, p. 85) is the *virtual space* created by electronic media, which regulates access to and channel of information. Hall & Graham (2004), for example, describe the mechanism of information and knowledge sharing in online communities. The third type of physical space is the *regulatory space*, which is defined by rules, plans, roles and resources (Hernes, 2004a, pp. 85-86). This space is, for example, a budget limit that allows an organisational unit to allocate resources internally, but constrains them as well. The regulatory space (for example bureaucracy) regulates the interaction of individuals (Hernes, 2004a, pp. 86-87). These physical spaces are constituted by the components of the organisational system (organisational context). According to Hernes (2004a, pp. 87-88) the physical space has two characteristics. Firstly, it is tangible and secondly it binds resources over time and space. These characteristics serve as stabilisation of human action and interaction (Hernes, 2004a, pp. 88-89). The physical space reproduces itself, just like for example budget (structure) shapes human action (process) and human action generates budget (Hernes, 2004a, pp. 97-98). Human actions are bound to the physical spaces (physical, virtual and regulatory) and its recursive reproduction of its structure and process.

### 3.5.5 *Mental space – system boundaries of the cognitive system*

The second space discussed by Hernes (2004a, pp. 101-114) is the mental space (cognitive system), which provides self-reproduction through thought. The mental space proposed by Hernes (2004a, pp. 103-105) incorporates Fleck's (1979) approach of 'thought collective' ('denkkollektiv'). This includes firstly the 'thought style', which sets the preconditions for cognition. Secondly, 'thought collective', which combines the similarity of thought processes with membership (for example different schools of thought) (Hernes, 2004a, p. 104). Thirdly, 'thought community', which comprises the members of the thought collective, but its members are not under the sort of constraints that members of the thought collective are (Hernes, 2004a, p. 104). Hernes (2004a, pp. 106-111) illustrates that this mental space in organisations relates to organisational learning and sensemaking. The concept of 'ba' (spatial knowledge creation) by Nonaka & Konno (1998) and Nonaka, et al. (2008) relates to the concept of mental space. 'Ba' is a space in which individuals create shared context and new knowledge, which includes the sharing of an individual's subject views or opinions in such a way that one can see oneself in relation to others and accept others' views and values (Nonaka, et al., 2008, p. 57). Different types of 'Bas' (spaces), namely, 'organising Ba', 'interacting Ba', 'cyber Ba' and 'exercising Ba' produce shared context and understanding within an organisation, which exceeds time and space (Nonaka & Konno, 1998, pp. 45-47; Nonaka, et al., 2006, pp. 1185-1186). Mental space reproduces itself through the cognitive autopoietic self-reference of individuals and the collective reproduction of mental spaces ('thought collective') within organisations, regions and society. This shared understanding of for example a society can prevent the introduction of new memes as argued by Csíkszentmihályi (1999).

### 3.5.6 *Social space – system boundary of the social system*

The last space discussed by Hernes (2004a, pp. 115-124) is the social space (social system), which comprises the organisation by bounding individuals through components such as loyalty, trust, identity and norms. The social space has been conceptualised in various forms such as social networks (strength of links of reciprocity), clans (intimacy) and communities (identity) (Hernes, 2004a, p. 116). Social space is established through the social bounding of individuals (third-order coupling), which establishes group boundaries and provides distinctions between groups (Hernes, 2004b). Social spaces can be temporary, but can become robust if individuals have shared key situations and events, especially at hard times (Hernes, 2004a, p. 117). Hernes (2004a, p. 118) states that communities as social spaces have the potential to spread and change the large social system (e.g. organisational culture). Furthermore, social networks have the characteristics to extend the space and provide stability through routinisation and stabilisation (principle of embeddedness) (Hernes, 2004a, pp. 119-120). This suggests that networks are long-term and outlast organisational change efforts and stabilise organisational relations rather provide impetus for change (Hernes, 2004a, pp. 119-120). Social systems are re-produced through social actions of individuals such as rituals and shared norms (Hernes, 2004a, pp. 121-122). Through social interaction among individuals, social spaces are created as temporary or momentary events and situations. The system can reproduce itself over time and space through continuous social interaction and social bounding.

### 3.5.7 *Conclusion on space*

Space allows examination of the situated context within momentary events (local context of interactions between individuals within time and space) and larger context (global context such as 'thought collectives', shared behaviour or culture and regulations and technology) within an organisation. The spaces are phenomena and, historical systems and reproduce themselves through their autopoietic organisation, which also interact with each other.

The combination of this theory of space and autopoiesis with the creativity and innovation theory as discussed in Chapter 2 (page 69) builds a framework for the investigation of the autopoietic organisation of knowledge, creativity and innovation as presented in Figure 3-9.

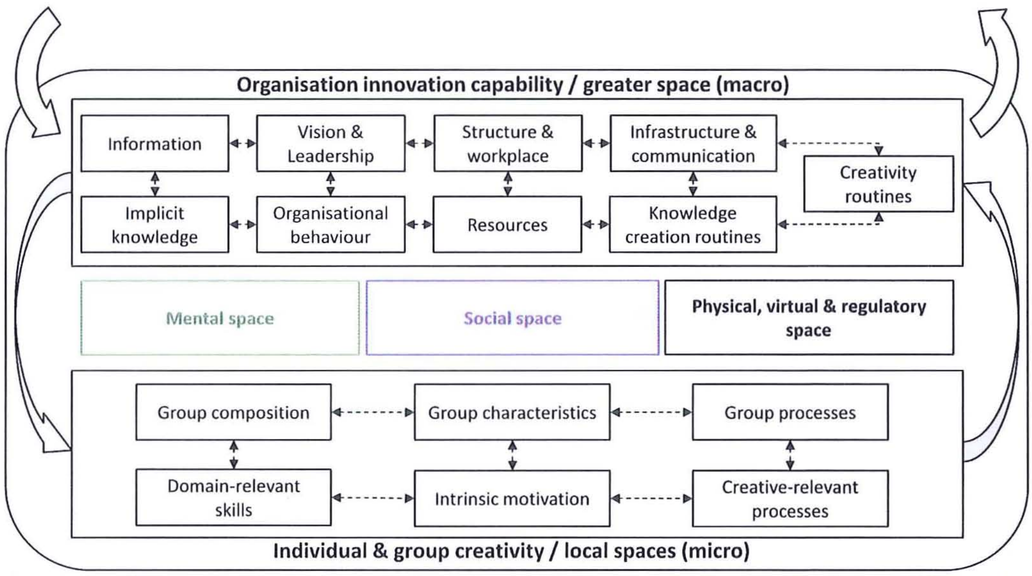



**Figure 3-9: Componential model of the autopoietic system of the organisation of knowledge, creativity and innovation**

This framework shows the organisational context of the innovation capability (greater space) and the fluid context of individual and group creativity (local spaces) and their recursive interactions (self-reproduction). These contexts can be subdivided into the three main spaces, namely, mental space, social space and physical, virtual and regulatory space. Hernes (2004a, pp. 125-139) emphasises the dynamic nature of these spaces. Spaces emerge and bring change either in itself (endogenous) or in another space (exogenous). These changes occur within the autopoietic production. Therefore, another dimension needs to be added to the framework; the dimension of change levels.

## 3.6 Change and systems

Change within systems is often discussed as either endogenous, within the system, or exogenous, from outside the system. Also change in human and natural system occurs within different system states (Holling, Gunderson, & Ludwig, 2002). These system states and the endogenous and exogenous influences relate to the complexity of multiple-levels and the resulting change. This section discusses the exogenous and endogenous influences and change, different system states related to change and change within the interaction of different levels.

### 3.6.1 *Endogenous and exogenous*

Change in a system can come from within a system (endogenous) and from the environment of a system (exogenous). The exogenous change (reactive change) in organisation refers to the organisational learning and adaptation. Adaptation to change from outside the company is vital for the organisation to sustain its operation (for example Cohen & Levinthal, 1990). Endogenous change (proactive change) can be linked to the organisational creativity theory. Creativity within an organisation is vital to produce innovation (for example Woodman, et al., 1993).

The theory of the input-transfer-output (and feedback) system requires, by its nature, a change in the environment (input) for change and innovation to occur. The autopoiesis view takes a different perspective in which a state of organisation actually comes about via processes of enactment (Hernes & Weik, 2007). This process of enactment centres the active role played by organisational members in creating, defining, giving meaning to and influencing their environment (Hernes & Weik, 2007, p. 258). The distinction of exogenous and endogenous change is not entirely satisfactory as change outside the organisation requires a change within the organisation. Innovation occurs not by either or, but by a combination of exogenous and endogenous change (Bakken, et al., 2009b, pp. 77-78). From this point of view,

> "An innovation can now be understood as an active 'production,' i.e. as an organisation activity where the surrounding, partly uncertain environment (e.g. the wants of the customer) gives a 'new' Gestalt. With a 'product innovation' an organisation 'produces' its customers base anew. A novelty in the form of an innovation is thus not to be seen as a reaction of an organisation to a demand from the environment, but rather

> an active variation. An enacting organisation can choose that which it deems meaningful to continue actively to constitute relevant environment like before, or it can choose to do things differently." (Bakken, et al., 2009b, p. 78)

Innovation is a function of both; the absorptive capacity such as open innovation by Chesbrough (2003, 2006), user groups by von Hippel (1988, 2005) and co-creation by Prahalad & Ramaswamy (2000) and Ramaswamy & Gouillart (2010) as well as functions of high level redundancy of new knowledge creation within the organisation as stated by Nonaka & Takeuchi (1995, pp. 80-82), Morgan (2006, pp. 105-108) and Bakken, et al. (2009a). Nevertheless, change relates to different phases of a system.

### 3.6.2 *System states and levels of change*

According to Fuchs (2003, pp. 155-157; 2004, pp. 191-193) evolution takes place continuously, but in sudden discontinuous leaps, which are different 'phases of development'. For example, capitalism is itself a sequence of different phases i.e. the structure of capitalism changes at a certain level and new qualities emerge (Fuchs, 2003, pp. 151-158). Within organisations, Luhmann (2000, 2003), for example, stated that bureaucratic organisation and decisions within organisations, which require elimination of all uncertainties, result in the reproduction of the same actions ('as we have always done'). Schumpeter (2010, pp. 71-92 [1950]) on the other hand describes a phase of creative destruction, which leads to the demise of the 'old' system. For example, disruptive technologies and innovation can cause diminishment the established existing system (Christensen, 1997). Gunderson & Holling (2002) identify different phases of change in human and natural systems.

Change emerges in different phases within a system. Several scholars have investigated and discussed different states of systems such as natural, human cognitive, social, business and general systems related to change as presented in Table 3-2 (page 100). For example, Johnson (2010, p. 52) uses the idea of Longton (1992), who uses a metaphor for the different phases of a system, namely, solid, liquid and gas. Johnson (2010, p. 52) states

> "Think of the behaviour of molecules in each of these three conditions, in a gas, chaos rules; new configurations are possible, but they are

> constantly being disrupted and torn apart by the volatile nature of the environment. In solid, the opposite happens, the patterns have stability, but they are incapable of change. But a liquid network creates a more promising environment for the system to explore the adjacent possible." (Johnson, 2010, p. 52)

Similar to the solid, liquid and, gas analogy there are four other categorisations of system states related to change, namely, simple, complicated, complex and chaotic as introduced by Snowden & Boone (2007). These system states are based on the assumption that circumstances in a system change as they become more complex. The simple and complicated states are inherent to observable cause-and-effect relationships, while in complex and chaotic systems there is no immediately apparent relationship between cause and effect, and the way forward is based on emerging patterns. The simple system or solid state is the state in which replicable and universal laws exist, while the complex and chaotic states impels innovation, because the system needs to reorganise itself in a novel way (Snowden & Boone, 2007).

| Ontological level | State I | State II | State III | State IV | Scholars |
|---|---|---|---|---|---|
| **Natural & human-systems** | Conservation (K) | Exploitation (r) | Reorganisation ($\alpha$) | Release ($\Omega$) | Gunderson & Holling (2002) |
| **Business systems** | Simple | Complicated | Complex | Chaotic | Snowden & Boone (2007) |
| **Cognitive & social systems** | Solid | Liquid | Liquid | Gas | Johnson (2010) |
| **Cognitive system** | Reproduction (mastery) | Behavioural adjustment | Producing one's style | Developing new style or technique | Weisberg (2006, p. 202) |
| **Innovation types** | Reproduction | Incremental innovation | Radical innovation | Disruptive innovation (creative destruction) | |

**Table 3-2: States of system which constrain or enable change to emerge (review of literature)**

### 3.6.3 *Panarchy*

Another model, which provides an explanation of the interconnection of the change states is the panarchy model by Gunderson & Holling (2002). This model is based on the assumption that complexity in living systems of people and nature emerges not from a random association of large number of interacting factors, but rather from a smaller number of controlling processes (Holling, 2001, p. 391). Holling (2001, p. 391) states

> "if sustainability means anything, it has to do with the small set of critical self-organised variables and the transformations that occur in them during the evolutionary process of societal development." (Holling, 2001, p. 391)

These governing processes consist of three properties, namely, (1) potential, (2) connectedness and (3) resilience, which shape the future responses of the ecosystem, agencies and people (Holling & Gunderson, 2002, pp. 32-33). Holling & Gunderson (2002, pp. 32-33) state that (1) potential is the inherent potential of a system that is available for change, which determines the range of options possible or alternatives for the future. (2) Connectedness or inherent controllability of a system is the degree of connectedness between internal controlling variables and processes, which reflects the degree of flexibility or rigidity of a system to control its own destiny (for example sensitivity or not to external variation). The adaptive capacity of a system is its (3) resilience; a measure of its vulnerability to unexpected or unpredictable shocks, which can be thought of as the opposite of the vulnerability of the system (Holling, 2001, p. 394). The two properties of (1) potential and (2) connectedness divide the model to four system states as presented in Figure 3-10.

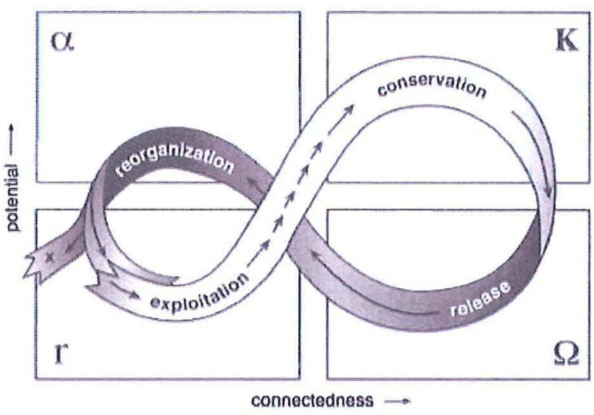



**Figure 3-10: Panarchy model– two dimensions of change: potential and connectedness (Gunderson & Holling, 2002, p. 34)**

The four system states are: exploitation (r), conservation (K), reorganisation (α) and release (Ω) (Holling & Gunderson, 2002, pp. 33-40). The exploitation (r) state is the state where dispersal ability and rapid growth within an arena occurs and scramble competition succeeds. This is equivalent to the entrepreneur market (Holling & Gunderson, 2002, pp. 32-33). The system state of conservation (K) consists of slower growth rates and flourish in an area of contest competition (Holling & Gunderson, 2002, pp. 33-40). Within the reorganisation (α) state of a system, innovation occurs in pulses or surges of innovation when uncertainty is great, potential is high and controls are weak so that novel re-combinations can form (Holling, 2001, p. 396). The release (Ω) state is the 'creative destruction' introduced first by Schumpeter (1950), which incorporates forces that lead to the system demise (Holling & Gunderson, 2002, p. 34). The different states emerge through the transformations of the system from one state to another within the systems' self-organisation (self-recreation and structural coupling).

The system transformation from exploitation (r) to conservation (K) ('front loop') is the long period of accumulation and transformation of resources such as skills, networks of human relationships and mutual trust that are developed incrementally and integrated during the progression from (r) to (K) (Holling, 2001, p. 394). The shorter period that creates opportunities for innovation is the transformation from release (Ω) to reorganisation (α) ('back loop'), which incorporates human behaviour within organisations as, for example, accumulation rigidities to the point of crises, then attempts to restructure (Holling, 2001, p. 394). Examples of the proximate agents of disturbance in these cases can be revolts by stakeholders, public-interest attacks through the legal system or more extreme societal revolts (Holling, 2001, p. 395).

The third dimension or property of a system that governs the change is (III) resilience. Resilience in its ecosystem sense represents the capacity of a system to experience disturbance and still maintain its ongoing functions and control (Holling & Gunderson, 2002, p. 50). From this view, a system's resilience expands and contracts throughout the cycle. It shrinks as the cycle moves towards (K), where the system becomes more brittle, and expands as the cycle shifts rapidly into a 'back loop' to reorganise accumulated resources for a new initiation of the cycle (Holling & Gunderson, 2002, p. 41). In relation to creativity and innovation, low connectedness and high resilience provide the environment within a system (organisation) for creative experimentation as the system-wide costs of failure are low (Holling & Gunderson, 2002, p. 40). The reorganisation (α) state can consist of high resilience and potential, while connectedness is low and internal regulation is weak (Holling & Gunderson, 2002, p. 41). Therefore, this is a state in which new connection in a system can occur similar to the 'liquid network' state.

### 3.6.4 *Multidimensional complexity of change*

According to Holling, Gunderson, & Peterson (2002) the adoptive cycle is the first of two features of the system change. The second feature is hierarchies as presented in Figure 3-11.

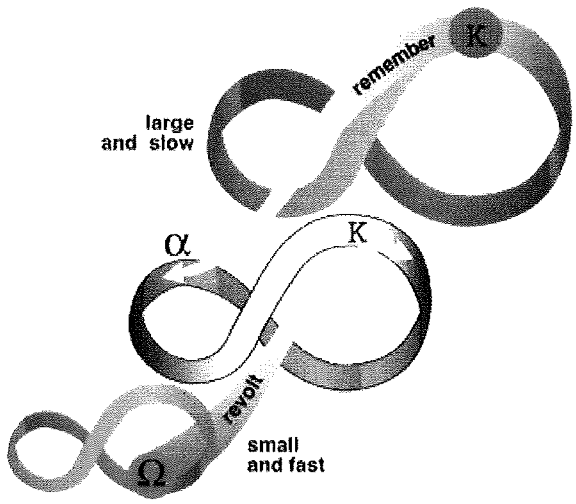



**Figure 3-11: Hierarchies and panarchies - Multi-dimensionality and panarchical connections of a system (Holling, Gunderson, & Peterson, 2002, p. 75)**

The structures of these hierarchies in social systems are based on the 'duality of structures' by Giddens (1981). Holling, et al. (2002, p. 72) argue that the slower levels emerge from experience of the faster and can have asymmetric interactions between them. The larger slower levels control (constrain and enable) the lower faster levels (Holling, Gunderson, & Peterson, 2002, p. 72). The lower faster levels transform the hierarchies from fixed static structures to dynamic and adaptive entities, whose levels are sensitive to small disturbances at the transition from growth to collapse (Ω state) and the transition from reorganisation to growth (α state) (Holling, Gunderson, & Peterson, 2002, p. 72). Furthermore, Holling, et al. (2002, pp. 72-73) pointed out during other times processes are stable and robust, constraining the lower level and immunity to buzz of noise from small and faster processes.

### 3.6.5 *Conclusion on change and systems*

This section indicated that change in systems such as a business domain can be changed from within through an organisation that produces change. Furthermore, this discussion revealed that creativity and innovation require a certain 'system state' for change to occur. This change can occur through the observation-adaptation (exogenous-endogenous) or through proactively change action and produce the change in the larger system (endogenous-exogenous). This function of change incorporates the reorganisation (self-reproduction) of task context. The challenge for organisations is to facilitate this dynamic capability that enables creative experimenting and the development and production of change.

## 3.7 Contextual framework: Autopoiesis, space and the organisation of knowledge, creativity and innovation

The organisation of knowledge, creativity and innovation incorporates several complexities: (1) multiple factors complexity; (2) multi-level complexity; (3) creativity and innovation are dynamic capabilities and emergent phenomena; (4) the innovator's dilemma of exploitation and exploration; (5) several system states are required within a system to adapt and innovate; (6) innovation requires both external information and internal function of redundancy. The autopoietic organisational system theory and theory of space allow individuals to talk about the several complexities within an organisation. This section discusses the approach taken to investigate the organisation of knowledge, creativity and innovation.

### 3.7.1 *Coupling the cognitive, social and organisational system*

The context within an organisation that can facilitate or prevent creativity and innovation in organisation consists of cognitive factors (cognitive system/mental space), social factors (social system) and physical, virtual and regulatory factors (organisational system). These contexts were described for individuals and individual interactions in section 2.4 (page 48) and section 2.5 (page 53) and large organisational context in section 2.6 (page 58). These different contexts produce mental, social and physical spaces as discussed in section 3.5 (page 89). These spaces interact with each other and produce patterns of momentary events within time and space (micro / 'organising') and patterns of large organisational context (macro / 'the organisation'). The interaction of the spaces that produce the space unity is illustrated in Figure 3-12.

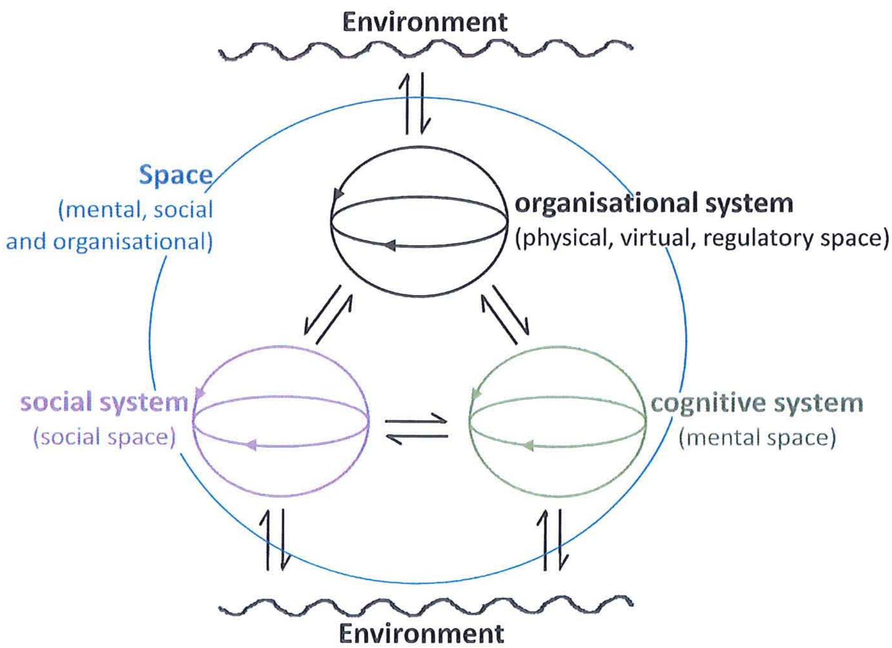



**Figure 3-12: Space unity of the cognitive, social and organisational system within the environment**

The figure shows the interactions (structural coupling) of the cognitive, social and organisational system which produce a momentary space (local context) within time and space and produce a large space of the organisation (organisational context), which can exceed time and space. The investigation of the interacting patterns that produce space unity requires an approach that can capture patterns of the organisational context (macro level) and the context within individual interactions (micro level).

### 3.7.2 *Interactions of multiple-level (duality of structure)*

The autopoietic theory of cognition, social autopoiesis and autopoietic organisation theory allows investigation of the different system at different levels.

An individual from a cognitive and knowledge perspective incorporates both codified knowledge (structure) and reproduction (intuitive knowing or tacit knowledge). Within an interaction (group) they can utter the codified knowledge. These interactions build the process of the group, while the structure is the momentary events of these interactions. These groups are organised as a network of interacting groups. The network structure can be seen as 'the organisation', while the process that produces the emergent structure is the 'organising' aspect. Organisations are themselves interconnected with other organisations such as suppliers within the supply chain and competitors in sales competition. This network builds the structure of the business domain, while the interactions of the organisations are the process that builds the business domain structure. This multi-level complexity is presented in Figure 3-13 (next page).

The process and structure of the different systems at different levels show the autopoiesis, while the outcome of each system is the heteropoiesis (space of human design). Heteropoiesis has been discussed by Maturana & Varela (1980, pp. 85-90). The autopoietic system theory provides an approach to investigation of the interactions of multiple-levels. These multiple-levels and their patterns need to be examined to identify the emergence of knowledge, creativity and innovation.

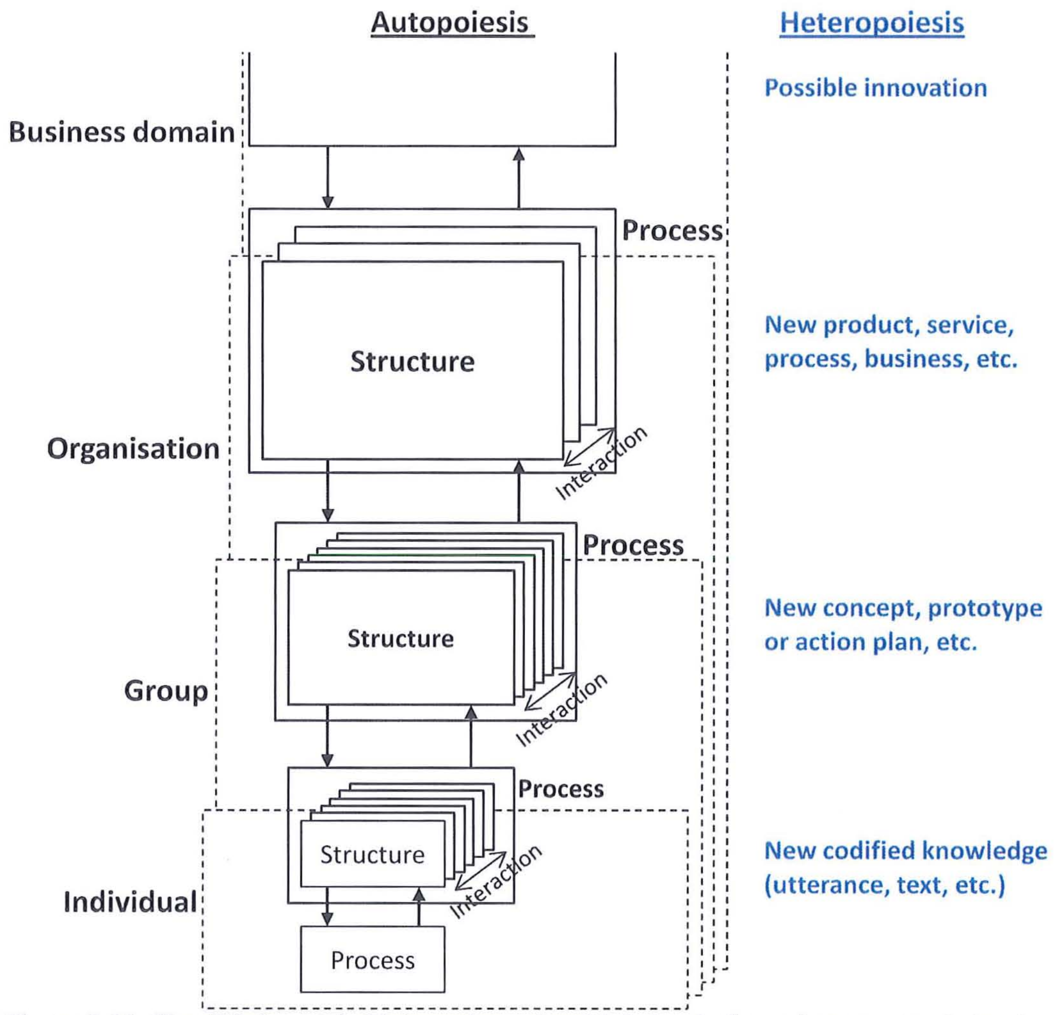


**Figure 3-13: Simplified model of interactions of multiple-levels through process and structure (autopoietic reproduction)**

### 3.7.3 *Pattern language*

Patterns within individual interactions and on the large scale of the organisation can be examined through a pattern language. Iba (2010, pp. 6621-6622) stated that the pattern language, which was originally introduced in architecture by Alexander, et al. (1977), allows examination of the patterns that facilitate creativity. Design patterns allow investigation of the different forces of a situation (Rising, 1998a). They also allow individuals to investigate the structure of an organisation (Coplien, 1998, 2006). The method of the pattern language allows investigation of the organisational context that produces the large space and the local context that produces spaces within interactions of individuals. Alexander et al. (1977, p. xiii) stated this as following:

> "In short, no pattern is an isolated entity. Each pattern exists in the world, only to the extent that is supported by other patterns: the larger patterns in which it is embedded, the patterns of the same size that surrounds it, and the smaller patterns which are embedded in it. This is a fundamental view of the world. It says that when you build a thing you cannot merely build that thing in isolation, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole; and the thing which you make takes its place in the web of nature, as you make it." (Alexander, et al., 1977, p. xiii)

This indicates that pattern language allows investigation of the (1) multiple factors (metal, social and physical, virtual and regulatory context) and (2) multiple-level complexity. These multiple factors and multi-level complexity leads to the next challenge; the challenge of (3) dynamic capability and emergent phenomena.

### 3.7.4 *Autopoietic organisation (dynamic capability and emergent phenomena)*

Standardisation can prevent creativity and innovation. Therefore, it requires a dynamic capability. Dynamic capability is also linked to the emergent nature of creativity and innovation. Creativity and innovation occur within emergent relationships. The autopoietic system theory provides an explanation of the emergent phenomenon and dynamic capability as the process (self-reference) produce emergent structure in cognitive system, social systems and in organisational systems. This allows examination of the emergent complexity. Furthermore, the structure turns into process and process produces the structure. This recursive interaction of process and structure indicates the dynamic capability within an organisation. Within this self-reproduction change occurs within different (5) system states, which relate to the innovator's dilemma of (4) exploitation and exploration and to (6) external knowledge creation (exogenous) and internal knowledge creation (endogenous). This complexity relates to the theory of space and organisation.

### 3.7.5 *Different spaces and change*

The theory of space and organisation provides an approach which allows the examination of different spaces in momentary events or situations in which creativity can emerge and the large space which facilitates creativity and innovation. This allows a view of the process of the organisation in which different spaces relate to different system states (for example exploitation or exploration) in different teams and different places at the same time (Delemarle & Larèdo, 2008). For example, one team in 'room A' is allowed to produce a space in which they explore new opportunities, while another team in 'room B' exploits existing opportunities. The space approach permits overcoming the 'ambidextrous organisation' (Delemarle & Larèdo, 2008, p. 191). It also allows individuals to overcome the idea of establishing an innovation culture throughout the organisation, but rather producing situated spaces, which facilitate creativity in individuals and individual interactions and innovation within large collectives.

Furthermore, spaces allow the overcoming of organisational boundaries through communities of innovation (Thrift, 2008b). Therefore, different produced spaces with customers or with internal project teams provide a new view of the endogenous and exogenous complexity. Mechanisms that produce space can establish internal and external spaces of situated knowing, creativity and innovation.

### 3.7.6 *Conclusion*

The approach of organisational theory, space, autopoiesis and change in systems allow researchers to investigate the different complexities of the organisation of knowledge, creativity and innovation. The challenge is to identify the large organisational context and the local context (mental, social and organisational), which dynamically produce spaces on multiple-levels that enable creativity and innovation to emerge within an organisation.

## 3.8 Conclusion

This chapter brought together the autopoietic system theory, theory of space and organisational theory of knowledge, creativity and innovation. These theories allow the investigation of creativity and innovation from a system perspective as discussed in section 2.2.3 (page 35). The autopoietic system model (space) permits investigation of firstly, both 'the organisation' as an entity (innovation capability) and the 'organising' of individuals (creative process), and secondly the recursive interaction between 'the organisation' (innovation capability) and 'organising' (creative process) as dynamic capability and emergent phenomenon of change. For understanding how creativity and innovation occurs within an organisation (system) one needs to identify the mental (cognitive system), social (social system) and physical, virtual and regulatory (organisational system) context. These different influences build patterns within momentary situations within individual interactions bound in time-space and patterns within the large organisational context which exceed time-space. These patterns not only reproduce themselves, they also produce the boundaries of the system. They produce spaces. These spaces allow co-innovation within an organisation such as exploitation and exploration and enable to produce different system states of local spaces at the same time. A simplified contextual framework of this approach is illustrated in Figure 3-14.

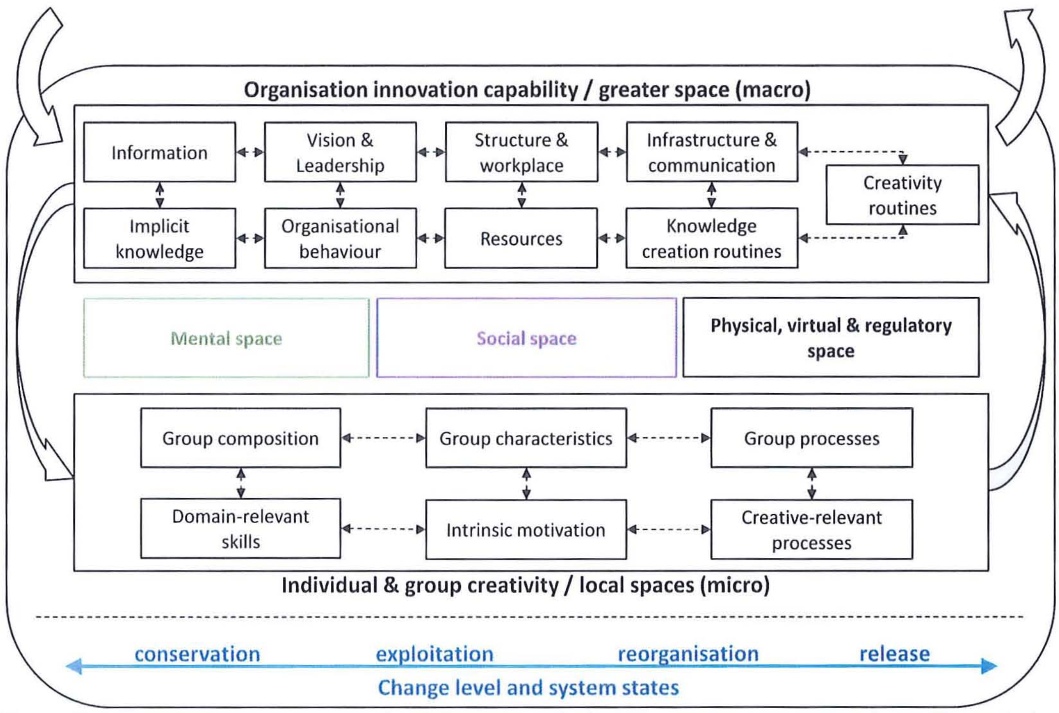



**Figure 3-14: Contextual framework of the autopoiesis system of the organisation of knowledge, creativity and innovation (including system states of change)**

The question this research aims to answer is which are the main factors and how do they underpin creativity and innovation in an organisation? This incorporates:

(1) multiple factors complexity;

(2) multi-level complexity;

(3) creativity and innovation are dynamic capabilities and emergent phenomena;
(4) the innovator's dilemma of exploitation and exploration;
(5) several system states are required within a system to adapt and innovate;
(6) innovation requires both external information and internal function of redundancy.

These complexities and dynamics need to occur within the self-reproducing context that produces the greater space (exceed time-space) and local spaces (bound in time-space) in which creativity and innovation can emerge and change can be established.

# Chapter 4 Methodology

*"Truth is the invention of a liar."*

*Heinz von Foerster* & Poerksen (2002, p. 13)

***Keywords***

Philosophy · Methodology · Research design · Research strategy · Methods · Data collection · Data analysis · Limitations ·

## 4.1 Introduction

The research investigates the autopoietic system perspective (self-producing view) of the organisation of knowledge, creativity and innovation. The core question, which this research aims to answer, is

> "what are the main factors and how do they underpin creativity and innovation in a large, global manufacturing company[3]?"

To answer this question, a particular research methodology was required. This chapter discusses the research methodology in relation to the research question. The chapter is organised into six parts.

1. The first part discusses the philosophical stance and, the researcher's axiological perspective and its implications.

2. The second part discusses the research design, which includes the choice research approach and strategy. The strategy of this research is a single in-depth case study of Daimler AG.

3. The chapter discusses the approach of investigation, research framework and process. The approach of investigation and framework links the research design and methods used.

4. The fourth part examines the methods used and their design, which are used to collect the data.

5. The data collection is discussed in the fifth part of the chapter; the field work. This part provides an overview of the case study and the process of collection of data.

6. The last part of this chapter covers data analysis and system modelling. This examines the analysis and modelling techniques used to examine the autopoietic system perspective of the organisation of knowledge, creativity and innovation.

[3] In this case Daimler AG

## 4.2 Research philosophy

The first methodological implication of the research is the epistemological, ontological and axiological perspective, in short the research philosophy. Research philosophy is concerned with the fundamental nature of knowledge, existence and reality. There are numerous philosophical perspectives within the social science domain, such as positivism, post-positivism, social constructivism, participatory and pragmatism Lincoln, Lynham, & Guba (2011) provide an overview of these. Pragmatism is discussed by Denzin & Lincoln (2011, p. 290) and Johnson & Onwuegbuzie (2004).

The different philosophical perspectives differ in their epistemology, ontology and axiology (for example Lincoln, et al., 2011). Epistemology is concerned with the nature of knowledge and its relation to notions such as truth and beliefs, while the concern of ontology is about the nature of being, existence and reality. Axiology is concerned with the researcher's values and aesthetics. From a simplified point of view, this 'triangle' defines the philosophical perspective.

The research philosophy of this study is pragmatism. Pragmatism is the philosophical stance, which builds a direct link between theory and praxis (Levin & Greenwood, 2011, p. 29). This pragmatic or applied sciences perspective rejects the "either or" choices of the philosophical paradigms, focuses on applied research and adopts the approach which best answers the research question (Tashakkori & Teddlie, 2003, p. 713). 'The organisation' as an entity is investigated through a 'hard system' approach and the 'organising' is examined by a 'soft system' approach. This research approach is closely linked to pragmatism.

The researcher's axiological perspective (values, ethics and aesthetics) is grounded in both the appreciation of natural laws as well as socially constructed complexity. The axiological perspective relates to pragmatism as it explains the problem of the relationship between the knower and the known from both a 'positivistic perspective' and 'social constructivist perspective' relevant to answering the question of interest. Furthermore, the researcher's axiological perspective embraces the valuation of theory and research grounded in practices. Pragmatism rejects the dichotomy of the mind and body and that they must be two ontologically different entities. In this sense, knowledge (mind and body) of the human being is embodied in and is itself a 'real world' object and event, which cannot be separated. This pragmatic principle is stated as following:

> "Pragmatism's principle of continuity claims that abstract thought is not disembodied; rather, it must arise from our sensorimotor capacities and is constrained by the nature of our bodies, brains, and environments. From an evolutionary perspective this means that we have not developed two separate logical and inferential systems, one for our bodily experiences and one for our abstract reasoning (as a pure logic). Instead, the logic of our bodily experience provides all the logic we need in order to perform every rational inference that we do." (Johnson & Rohrer, 2007, pp. 32-33)

This means that scientific knowledge is embodied and theory is grounded in practice and practice is informed by theory. Furthermore, pragmatism is not restricted to a philosophical "either or" choice and can therefore investigate complexity from different philosophical perspectives. In the context of this research, the philosophical approach of pragmatism allows the investigation of both the 'absolute view' (structuralism) and the 'process view' (interactionism or phenomenology) as the non-separable interrelation ('self-producing view') by using appropriate scientific method. This permits the examination of the organisation of knowledge, creativity and innovation to form an autopoietic system theory perspective.

The strength of this methodological pluralism is that it holds the potential to break with previous established assumptions (Baert, 2005). The problem with methodological pluralism is that it can result in contradictory findings and complex data (Easterby-Smith, Thorpe, & Jackson, 2008). When designed well, the approach holds great potential to reveal new knowledge about the complex and dynamic nature of the self-producing system of creativity and innovation in organisations.

## 4.3 Research design

The research aimed to investigate main factors that underpin creativity and innovation within a particular case. This investigation is based on the autopoietic system perspective of the organisation of knowledge, creativity and innovation. To accomplish this aim and to answer the research question a particular research design is required. The research required a system investigation including the identification of key influences and their interrelations (patterns) both at the micro level (individual interactions) and macro level (the organisation), collection of in-depth and contextual data, a promising case to examine the phenomenon studied and an approach that captures the inherent complexity. This research design embraces firstly the approach of theory elaboration as it allows the use of existing theories (as discussed in Chapter 2 and 3) as well as theory-building. Secondly, explanatory research with exploratory elements allows explanation of how contextual influences produce spaces that facilitate creativity and innovation within organisation. Thirdly, an in-depth case study is required to investigate both local context within interactions among individuals and large organisational context. This section discusses the research design that permits the investigation of the autopoietic organisation theory of knowledge, creativity and innovation.

### 4.3.1 *Theory elaboration*

Research design can have three main approaches: (1) theory testing; (2) theory elaboration or (3) theory generation (Lee, Mitchell, & Sablynski, 1999). Theory testing is used to test a hypothesis or existing theory, while theory generation is used to build a new theory in which little is known. Theory elaboration is used when building a new perspective or theory of existing research or theories (Lee, et al., 1999, pp. 166-167).

The research aimed to investigate the cognitive, social and organisational influences that produce patterns and spaces to facilitate creativity and innovation. Several studies have identified numerous cognitive, social and physical, virtual and regulatory influencing factors (as discussed in section 2.4, page 48 to section 2.6, page 58). These identified influence factors provide a good ground for identifying patterns and dynamics, which produce spaces of creativity and innovation. Through pre-existing influence factors and empirical research these patterns can be examined, which allows elaboration of a new theory. This research design and process is illustrated in Figure 4-1.

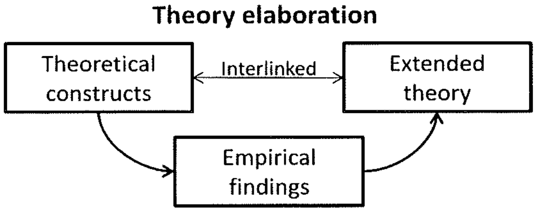



**Figure 4-1: Research design and process: Theory elaboration**

As shown in Figure 4-1 theory elaboration allows redirection and reconnection of theory and empirical research (Lee, et al., 1999, p. 166). Theory-driven research that aims to extend existing theory needs justification of why inductive theory building is necessary (Eisenhardt & Graebner, 2007, p. 26). The use of theory-building is appropriate when little is known about the phenomenon, current perspectives seem inadequate or conflicting, the need for new perspectives is suggested by previous research or research is in its early stages (Eisenhardt, 1989, p. 548). Several leading scholars in the domain of organisational creativity and innovation theory have suggested that a new perspective is required as summarised in Table 4-1. The table shows the advice from academic literature and the adopted research approach of this study.

| Advice from academic literature | Research approach |
|---|---|
| Creativity is influenced by multiple levels from individual skills to team dynamics to organisational climate. Given this complexity very little research has investigated the phenomenon in the context of real organisations (Amabile & Mueller, 2008) | Investigation of the dynamic recursive interactions of the large organisational context (macro) and local context of interactions between individuals (micro) to capture the entire complexity within an organisation. |
| Much is known about individual creativity and organisational change, organisational creativity research can be extended through linking existing theory (Woodman, 2008) | Examination and linkage of pre-identified influence factors (pre-existing theory) with empirical findings to extend theory. |
| Creativity and innovation occurs within certain conditions of a system and emerges in relation to that system (Csíkszentmihályi, 1999). Therefore, the system needs to be investigated to reveal the complex and dynamic nature of creativity and innovation. | A system investigation of the complex and dynamic interrelations of influence factors to reveal system dynamics that produce spaces, which give explanation of how creativity and innovation emerges within the context of an organisation. |
| There is little known about the nature of creativity. Through coupling several systems such as the cognitive and social system with creativity, new insight can be revealed (Iba, 2010) | Identification of patterns through examining the interrelations of physical, virtual, regulatory, social and cognitive influence factors (coupling of systems) to reveal the complex nature of creativity and innovation in organisations. |

**Table 4-1: Advice from academic literature and adopted research approach**

The research rejects a theory testing approach as a new perspective is required, which takes into account the multi-level and multiple factors complexity of creativity and innovation in organisations. Furthermore, a grounded approach would avoid taking into account the large amount of research done in the domains of creativity, innovation and organisational research. Therefore, a grounded approach might replicate current findings rather than extend current theory through a new perspective.

Another motive for adopting theory elaboration is a practical reason. Miles & Huberman (1994, pp. 16-18) and Andersen & Kragh (2010) recommend avoiding both extremes of purely grounded research on the one side, and a too tightly structured approach to existing theory on the other. The use of existing theory provides orientation and direction within the research project (Miles & Huberman, 1994, pp. 16-18). However, it can restrict the view of the phenomenon studied (Andersen & Kragh, 2010). Therefore, the research adopts a 'hybrid design' of theory elaboration. This allows direction for the research as well as challenge of taken-for-granted assumptions. Andersen & Kragh (2010) stated that a loose strategy is the most likely to lead to insights that may seriously challenge taken-for-granted assumptions within a particular research domain. This opening up to alternative ways of framing empirical data allows a new perspective or theory to emerge. Eisenhardt & Graebner (2007) puts this as follows:

> "The theory is emergent in the sense that it is situated in and developed by recognizing patterns of relationships among constructs within and across cases and their underlying logical arguments." (Eisenhardt & Graebner, 2007, p. 25)

This indicates that identifying patterns of relationships among pre-identified theoretical constructs allows new theory to emerge. The research approach of pattern investigation allowed theory-elaboration. This can provide an explanation of how spaces are produced in which creativity and innovation can emerge. To reveal the patterns of both local and large organisational context, the research requires an explanatory research design.

### 4.3.2 *Explanatory and exploratory research*

There are different types of research to investigate a phenomenon: (1) exploratory; (2) descriptive and (3) explanatory studies (Yin, 2006, pp. 3-27). Exploratory research aims to define the question and hypotheses of a subsequent study, while descriptive research aims to provide a complete description of a phenomenon (Yin, 2006, p. 5). Explanatory research aims to explain how events happen through the identification of relationships (Yin, 2006, p. 5). The identification of relationships (patterns) between influence factors permits an explanation of how certain contextual patterns facilitate creativity and innovation. Explanatory research was adopted in this case to reveal the interrelations between the influence factors. Within these complex and dynamic interrelations further influence factors may interrelate in the relationship. Therefore the research design incorporated exploratory elements to reveal further relevant vital influences. This explanatory research approach with exploratory elements allowed the investigation of relationships between key influence factors and, furthermore, the identification of further factors relevant to the explanation. The research design permitted the investigation and modelling of the autopoietic system in relation to creativity and innovation. This approach required a research strategy that allows the collection and analysis of in-depth and contextual data.

### 4.3.3 *Research strategy: Single in-depth case research*

Several research strategies can be adopted to answer the research question. Yin (2003, pp. 1-18) compared the strategies of experiment, survey, archival analysis, history and case study. According to Yin (2003, p. 7) explanatory research favours the adoption of either an experiment, an historical approach or a case study as an appropriate research strategy. Furthermore, the case study approach is preferred when examining contemporary events and relevant behaviour, which cannot be manipulated (Yin, 2003, p. 7). It is very difficult to manipulate behaviour towards creative accomplishment within the full complexity of an organisation. Therefore, case study research was adopted. It allowed contemporary events to be studied with a full variety of evidence such as documents, artefacts, interviews and observation

(Yin, 2003, pp. 7-9). Moreover, a case study strategy has been chosen by many leading scholars within the domain (Zhou & Shalley, 2008, pp. 18-20).

The strategy of case research is conducive to the research design of theory-elaboration and system investigation. Case research permits theory elaboration (Eisenhardt, 1989). Eisenhardt & Graebner (2007, p. 25) argued that theory-elaboration from case research is surprisingly objective, because it's close adherence to the data keeps researchers 'honest'. Furthermore, Eisenhardt (1989) emphasised that case research to elaborate theory has strengths such as novelty, testability and empirical validity. A further important characteristic of the case study strategy is that it allows the retention of holistic and meaningful characteristics of real-life events (Yin, 2003, p. 2). This is conducive to the system investigation as it allows an holistic or system view.

Case study as a research strategy demands the choice of either a single-case or multiple-case design (Yin, 2003, pp. 39-56). Multiple-case design has the advantage of greater generalisability compared to single-case design. In contrast, Siggelkow (2007) stated that theory can be elaborated through the persuasive power of a single case. Furthermore, a multiple-case design would be unpractical for a system investigation as limited time and resources would limit the study in collecting in-depth and contextual data. The multiple-case design was rejected to be able to focus on in-depth contextual data collection and analysis within the given limited time and resources. The limitations of the single-case design as identified by Miles & Huberman (1994), Robson (2011) and Yin (2003) are

- findings are not generalisable in the conventional sense
- case studies are not seen as scientific from a 'natural science' perspective
- complexity of case study is difficult to represent simply
- data collection can result in a very large data set

Nevertheless, Yin (2003, pp. 39-42) emphasised that a single case study can represent a significant contribution to knowledge and can refocus future investigation. The strategy of a single case study can contribute to knowledge through the provision of context-knowledge and experience through placement within the phenomenon studied, falsification through the identification of a case where a theory is not applicable, appropriate in-depth insights, no greater bias than other designs of inquiry and substantial elements of narratives of the phenomenon studied (Flyvbjerg, 2001, 2006). When choosing a case study strategy one is required to select a case.

### 4.3.4 *Case selection*

The case organisation in this research was Daimler AG. This single in-depth case study provided a great opportunity to contribute to the scientific domain by investigating an appropriate and promising case (revelatory case) as pointed out by Yin (2003, pp. 40-42). Daimler AG was chosen as a case study for the following two reasons:

1. The research was supported and partly funded by the company and access was granted for data collection.
2. Daimler AG is one of the leading automotive manufacturers with a long history of producing innovation within the automotive manufacturer domain ("125 years of innovation," 2010). This made it an excellent case to investigate the main factors underpinning creativity and innovation.
3. Daimler AG is a promising case, because the company establishes and maintains continuous innovation in areas such as design, safety, comfort and alternative engines ("125 years of innovation," 2010).
4. Creativity and innovation plays a prior role and is proactively supported to avoid diminishing the source of innovation within the company ("Mercedes-Benz TecDay Innovations: 'Room for free and creative thinking'," 2010).

This single case organisation allowed an in-depth study of creativity and innovation in organisations. Furthermore, each case study incorporates the selection of units of analysis within the case (Yin, 2003, pp. 39-40).

### 4.3.5 *Units of analysis*

The selection of the unit of analysis within case study research can be basically separated into two choices: (1) holistic with a single-unit of analysis and (2) embedded with multiple units of analysis (Yin, 2003, pp. 39-46). For the autopoietic system perspective, the large organisational context (macro level) and the local context (micro level) needed to be taken into account. These two levels recursively interact and build the self-production of the organisation (autopoiesis) as presented in Figure 4-2. This allows analysis of the multiple units of analysis within the micro level, while maintaining a holistic analysis of the organisation (macro level).

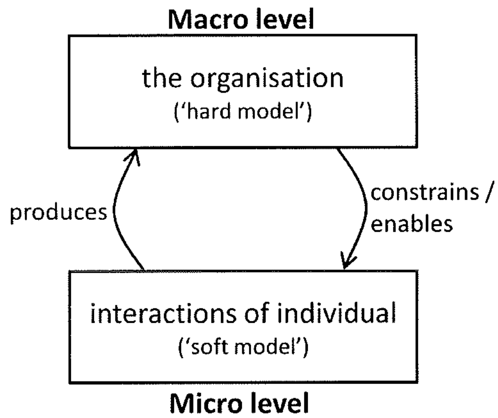



**Figure 4-2: Recursive interaction of the macro-micro level. Based on the autopoietic organisation theory (Hernes, 2004a, 2007; Magalhães & Sanchez, 2009a) and concepts of the 'hard-soft model' relationship (Pidd, 2004, p. 19).**

This autopoietic systems approach allows a holistic analysis of the organisation and, at the same time, the investigation of several units of analysis at the micro level and most importantly their recursive interaction.

### 4.3.6 *Conclusion to research design*

This research design permitted the examination of in-depth contextual data on multiple-levels. It allowed the investigation of the recursive interaction of the organisational context and context within interactions between individuals in relation to creativity and innovation. An investigation of the autopoietic system required such a pragmatic approach. The suitable site of Daimler AG supported the in-depth investigation of the context that facilitates creativity and innovation and allowed the elaboration of an explanation of the main factors and how do they underpin creativity and innovation. To reveal the main factors and their dynamics that underpin creativity and innovation a system investigation of the multiple levels is required.

## 4.4 System investigation, research framework and process

The context of the macro level deals with large populations, and therefore requires an investigation that can capture shared behaviour, assumptions and conditions. Such an investigation relates to 'hard' system modelling. In contrast, the micro level context deals with small numbers of individuals, and therefore requires an investigation that allows the capture of the fluid process or flow of interactions between individuals. This investigation requires a 'soft' system enquiry. The research requires both a 'soft system' and 'hard system' approach to investigate both the structure of 'the organisation', its fluid process ('organising') and the recursive interaction between both. The research rejects a pure 'hard system' approach as this would only allow examination of the structure of 'the organisation'. It also rejects a pure 'soft system' approach. The 'soft system' methodology allows an investigation of the fluid process, but does not allow an examination of the large structures. Therefore, a mixed method approach of both 'hard' and 'soft' system approaches is required. The challenge of a mixed methods design is the integration of the different data sets. A research framework permitted theoretical bracketing, which allowed integration of the different data set as pointed out by Maxwell & Loomis (2003). Furthermore, it provided guidance for the research process including the system investigations and modelling as advocated by Andersen & Kragh (2010). This section discusses the system investigation approaches, research framework and its role in the research process.

### 4.4.1 *System investigation and modelling*

The large organisational context (macro level) was examined by a quantitative approach ('hard' -model), while the local context within interactions of individuals was investigated by a qualitative approach ('soft' -model). These two models interact and feed off one another in an eclectic and pragmatic way (Pidd, 2004, p. 19). According to Checkland & Scholes (1999, pp. A9-A11), 'hard' system models are observable systems, while 'soft' system models are observed complexity, which can be organised as a learning system. Checkland & Holwell (2004) provides a comparison of the 'hard' and 'soft' system thinking approach as presented in Table 4-2.

| Hard system thinking | Soft system thinking |
|---|---|
| Oriented goal seeking | Oriented to learning |
| Assumes the world contains system that can be 'engineered' | Assumes that the world is problematical but can be explored using system models of concepts of purposeful activity to define 'action to improve' |
| Assumes systems models to be models of (part of) the world (ontologies) | Assumes systems models to be devices: intellectual constructs to help debate (epistemologies) |
| Talks the language of 'problems' and 'solutions' | Talks the language of 'issues' and 'accommodations' |
| Philosophically: positivistic | Philosophically: phenomenological |
| Sociologically: functionalist | Sociologically: interpretive |
| Systemicity: lies in the world | Systemicity: lies in the process of inquiry into the world |

**Table 4-2: Hard and soft systems thinking compared (Checkland & Holwell, 2004, p. 56)**

A coherent description of an engineering approach of the system investigation and modelling ('hard systems' models) is provided by Sterman (2000). This modelling process incorporates the following basic steps as identified by Sterman (2000, pp. 83-105):

- Problem articulation (boundary selection)
- Formulation of dynamic hypothesis
- Formulation of a simulation model
- Testing
- Policy design and evaluation

For 'soft system' modelling, Checkland & Scholes (1999, pp. 27-53) provide a enquiry process of soft systems modelling with the following steps:

- Problem situation – considered problematic
- Problem situation – expressed
- Root definitions of relevant and purposeful activity systems
- Conceptual models of the systems (holons) named in the root definition

- Comparison of models and real world
- Changes: systematically desirable and culturally feasible
- Action to improve the problem situation

The two system investigation and modelling processes allows examination of the structure of 'the organisation' (macro level) and the process, the 'organising' (micro level). These two levels cannot be investigated separately as the recursively interact, therefore theoretical bracketing and a research framework was used to integrate the two system models.

### 4.4.2 *Research framework of key concepts*

The research framework was used to adopted to express the boundaries of the research, give the data collection direction, guide the analysis and provide reproducibility of the research (Dubois & Gadde, 2002). Furthermore, it allows the interlinkage of the 'hard' system model of the macro level and 'soft' system model of the micro level. The research framework was developed according to Miles & Huberman (1994, pp. 18-22). This incorporated the definition of 'intellectual bins' and main constructs, factors and variables. Miles & Huberman (1994, p. 18) stated this as follows:

> "Theory building relies on a few general constructs that subsumes a mountain of particulars. [...] Any researcher, no matter how inductive in approach, knows which 'bins' [categories] are likely to be in play in the study and what is likely to be in them." (Miles & Huberman, 1994, p. 18)

A research framework graphically explains the main constructs within categories and the presumed relationships among them (Miles & Huberman, 1994, pp. 18-22). The research framework was constructed through pre-existing theory relevant for the study and personal experience as advocated by Maxwell & Loomis (2003, p. 247). The research framework consists of nine 'intellectual bins', which are based on the literature described in detail in section 2.6 (page 58). These nine 'intellectual bins' are presented in the contextual framework on the macro level (Figure 3-14 on page 110) and are listed in Table 4-3.

| Section | 'Intellectual bins' |
|---|---|
| B | Information and explicit knowledge |
| C | Implicit knowledge |
| D | Vision and leadership style |
| E | Organisational behaviour and climate |
| F | Organisational structure and workplace |
| G | Resources |
| H | Infrastructure and communication |
| I | Knowledge creation routines |
| J | Creativity routines |

**Table 4-3: Categories or 'intellectual bins' of the research framework**

These 'intellectual bins' embrace discrete events, conditions and behaviour, which are relevant to the phenomenon studied (Miles & Huberman, 1994, p. 18). The research framework is illustrated in Figure 4-3.

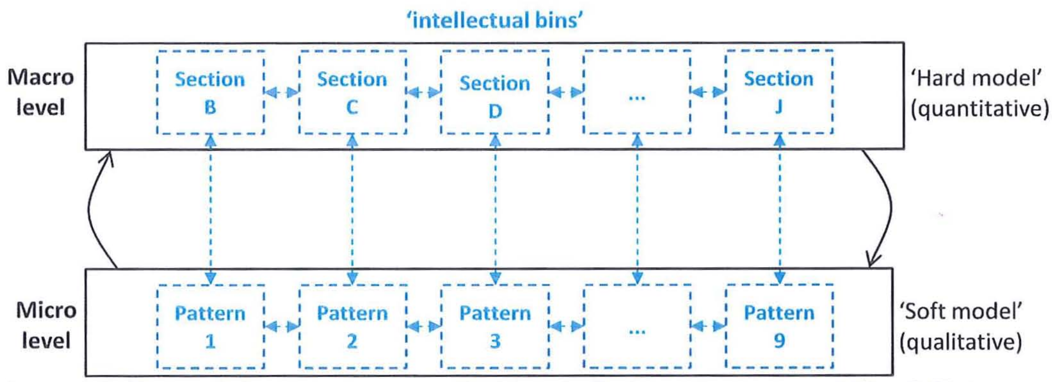



**Figure 4-3: Research framework (theoretical bracketing) as advocated by Miles & Huberman (1994)**

The framework shows the macro level (large organisational context), examined by a 'hard' system approach and the micro level (local context within individuals' interactions) investigated by a 'soft' system approach. Each level consists of 'intellectual bins' [blue dotted rectangles], which relate to each other [illustrated as blue dotted arrows]. This methodological bracketing permitted the integration of multi-level research (Miles & Huberman, 1994, pp. 16-18). It allowed an investigation into the large organisational context in relation to the local context and vice versa. Each of these 'intellectual bins' were linked to innovation (macro level) and creativity (micro level) to identify their relationship to creativity and innovation in organisations. The framework furthermore guided the research process.

### 4.4.3 *Research process*

The research framework provided guidance for the research process. There are two extremes of how a research framework can guide research: (1) by a 'tight structure'; (2) by a loose and 'emergent structure' (Miles & Huberman, 1994, pp. 16-18). Miles & Huberman (1994, pp. 17-18) advocated avoiding both ends of the extremes for practical reasons. Dubois & Gadde (2002) introduced a systematic combination, which incorporates a 'tight' and 'evolving' framework. This offered the opportunity to firstly match pre-existing theory with empirical findings through a 'tight structure'. Secondly, it allowed a new perspective of the theory to emerge (theory elaboration), inspired by empirical observations through a 'loose structure' approach as discussed by Dubois & Gadde (2002). The research of this thesis adopted a similar strategy. The research framework starts with a 'tight structure' approach and ends with an 'emergent structure' approach to extend theory as presented in Figure 4-4.

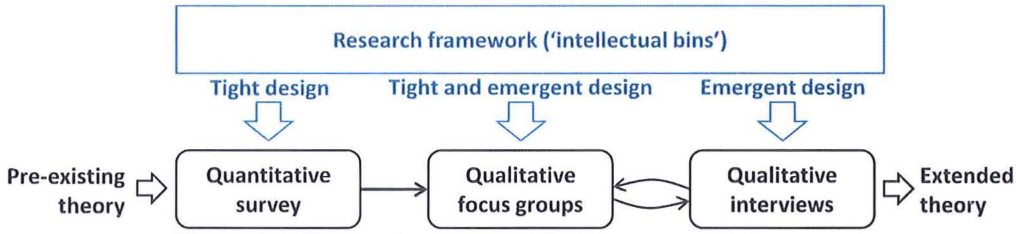


**Figure 4-4: Research process guided by a research framework**

The adoption of a pre-structured research framework based on existing theory has the issue of self-referencing existing literature (Siggelkow, 2007). Therefore, it is important to state that no potential theoretical construct is guaranteed a place in the resulting theory (Eisenhardt, 1989, p. 536). In contrast, the linkage of empirical findings with pre-existing theoretical constructs provided the potential of greater generalisability of the findings. This approach provided a good ground for theory elaboration through a deep, fully-formed explanation of the phenomenon studied as advocated by Eisenhardt (1989, p. 536). It permitted theory elaboration through a systematic discovery of an order within complex real-life observations as stated by Dubois & Gadde (2002).

### 4.4.4 *Conclusion to research framework and process*

The two system modelling approaches allowed examination of the influence factors on the macro and micro level. The research framework and its 'intellectual bins' provided guidance throughout the research process and permitted the integration of the two system models. For the data collection, analysis and modelling of the system models, one needs to define relevant research methods.

## 4.5 Research methods

The investigation of the 'hard' system model and the 'soft' system model requires a mixed methods approach. A quantitative survey method was used to collect data to model the 'hard' system model, which allowed the investigation of a larger population. The research methods used to collect data to design the 'soft' system model were qualitative focus groups and interviews. This section discusses the design of the research methods and the construct measurement or examination.

### 4.5.1 *Quantitative survey method*

The quantitative survey method was adopted to investigate the organisational context (macro level) in relation to the organisational innovation capability. The survey was designed to examining the work context through assessing the perception and experience of employees. This approach has been used in several organisational creativity studies (Shalley & Zhou, 2008). There are several designs to assess employees' perceptions (Czaja & Blair, 2005; Gillham, 2000). The design used in this research was a self-administered internal postal questionnaire. Dillman (2000) and Simmons (2008) discuss different questionnaire designs. This survey embraced a structured questionnaire design with specific questions and predetermined possible answers as stated by Gillham (2000, pp. 15-32). The benefits of this design were the collection of generalisable information from case population, the high amount of data standardisation, a straightforward approach to study attitudes, values, beliefs and motives, provision of respondent anonymity and there was less subjective bias as identified by Gillham (2000, pp. 5-8) and Robson (2011, p. 241). In contrast, this survey design did have limitations such as that misunderstandings could not be corrected, questions needed to be simplified and data subjects might not have responded with their true beliefs and experiences (Gillham, 2000; Robson, 2011, pp. 240-241). Nevertheless, the survey design permitted the measurement of organisational constructs as advocated by Easterby-Smith, et al. (2008, pp. 229-230). The survey investigation needs both a general choice of design as well as good measurement design.

The process of measurement is guided by the research framework (refer to section 4.4.2, page 125). Within each category of the framework several questions were designed to measure and examine related pre-identified variables. For example, statements that represented variables or constructs of different leadership practices were measured within the category of vision and leadership. The questionnaire can be found in Appendix C (page 365). The questionnaire incorporated in total one hundred and twelve statements to be rated. Ninety six were designed to measure organisational context. Each of the nine categories of the research framework incorporated six to thirteen measured variables. Ten statements were deliberated to measure the organisational innovation performance. Six additional questions were included to identify shared perception about definitions, but were dismissed in the analysis as they did not contribute to the investigation.

The constructs and organisational performance were rated by a scaled response as suggested by Gillham (2000, pp. 31-33). The scaled response used was a four-point Likert style scale as presented in Table 4-4. The measurement of attitudes with the Likert style scale consisted of a series of statements, to which the respondent indicated a degree of agreement or disagreement as discussed by Corbetta (2003).

| | Totally disagree | Disagree | Agree | Totally agree | Not applicable |
|---|---|---|---|---|---|
| Statement | 1 | 2 | 3 | 4 | 0 |

**Table 4-4: Four-point Likert style scale**

Similar approaches have been used to investigate organisational creativity (Shalley & Zhou, 2008). Shalley & Zhou (2008) summarised several field study designs with different rating scales to measure creativity in organisations. There is a discussion in literature about the impact of different rating scales in relation to the measured construct. The item scale between 5-point scales and 7-point scales shows no statistical difference (Dawes, 2008). Similar findings were found in the comparison of a 4-point and 6-point item-scale in terms of reliability and validity (Chang, 1994). The 4-point item-scale has been identified as having greater internal reliability (Chang, 1994). It was assumed that different scales within similar item scaling areas would not have a dramatic impact on the responses. However, the elimination of the neutral choice (mid-item) impacts on the response as it forces the respondent to make a choice (Gillham, 2000, p. 32). Adelson & McCoach (2010) compared the 4-point scale with a 5-point scale and identified that the number of response categories (four or five items) does not affect largely how the construct is measured within its specific context.

Measurement using a Likert style scale produces comparable data and can be used with parametric statistics and small sample sizes as argued by Norman (2010). The method permitted the design of a system model through the use of the confirmatory factor analysis (CFA) to identify the key influence factors and through Pearson's correlation analysis technique to examine the relationships between the key determinants. Therefore, the questionnaire methods allowed investigation and modelling the 'hard' system model of the organisational context in relation to the organisational innovation capacity. The initial findings of the quantitative survey were presented to focus groups.

### 4.5.2 *Qualitative focus groups method*

The qualitative focus group method was adopted to investigate how the organisational context (macro level structure represented by the findings of the questionnaire) turns into a process of context of interactions among individuals (micro level) and how this local context produces spaces in which creativity can emerge. The focus groups were designed to discuss the context of the macro level and its role within interactions between individuals. For the design of focus groups one needs to define the choice of questions, group composition and the quantity of conducted focus groups.

The choice of questions included the presentation of the key findings of the quantitative survey. This allowed examination of the organisational context in relation to the context within individual and group situations. The presentation of these findings provided a stimulus for and structure within the group discussion as advocated by Barbour (2007). Furthermore, this enabled focus groups members to reflect their own experience with the questionnaire findings.

The size of the group and representation of population are further elements that need to be taken into account when designing focus groups. There is no optimum amount of participants within a focus group. However, the participant number should range from around six to twelve participants (Barbour, 2007, pp. 59-60; Robson, 2011, pp. 295-296). Furthermore, characteristics of the participants such as personalities, background and relationships can influence group discussions (Barbour, 2007). For example, pre-existing and well-established relationships between the group participants have an impact on the group dynamics and discussions as pointed out by Robson (2011, p. 295). Therefore, the data was triangulated with data from several interviews with individuals from different organisational functions and personal backgrounds.

The number of focus groups conducted is another concern. Barbour (2007, pp. 59-60) states that

> "there is no magic number, but holding two focus groups with similar characteristics may place the researcher on firmer ground in relation to making claims about the pattering of the data, since it would suggest that differences observed are not just a feature of a one-off group." (Barbour, 2007, pp. 59-60)

Therefore, the focus group method was designed to collect data from two focus groups with very similar characteristics from similar organisational functions, but from different departments. Furthermore, the role of the moderator was considered as an influential factor in the discussions. Therefore, the design and process needed to be tested to provide a feedback opportunity on the moderator's influence as recommended by Krueger & Casey (2000).

This method has several limitations such as only limited questions can be asked, less articulate or enthusiastic participants may not have shared their view, conflicts can arise, confidentiality can be difficult in groups and that results may be difficult to generalise (Robson, 2011, pp. 294-295). To overcome the lack of in-depth information and broader context, face-to-face interviews were also conducted to gather in-depth and contextual information. Through the limitation of questions, the focus group design incorporated only discussions on the key influence factors related to the organisational innovation capability.

This method allowed the collection of experience from participants about local context influence factors determined by the large organisational context. These experiences were mined to extract patterns (DeLano, 1998). These patterns incorporated key influence factors and their relationships and provided an explanation of how creativity is facilitated within spaces of individual interactions and group situations. These patterns are based on views and different experiences, brought together in a consensus within the discussions. The technique was not good in accessing narratives and attitudes, but was good in accessing insights into experience (Barbour, 2007, pp. 15-28). A further important contribution from the focus group method was the integration of the data sets, as it is a complementary method with both questionnaires and interviews (Barbour, 2007, pp. 44-46). This allows examination of the recursive interrelation of the organisational context ('hard' system model) and the local context ('soft' system model). The 'soft' systems investigation and modelling included the collection of interview data.

### 4.5.3 *Qualitative interviews*

The purpose of the interview method was to collect data to support or challenge the findings from the focus groups and to investigate the local context that produces the spaces of creativity. The qualitative interview method was adopted for several reasons. Firstly, interviews allow researchers to examine diverse individual perspectives. Secondly, the method allowed the examination of further influence factors, which helps support a new theory to emerge. Thirdly, the interviews are a good method of revealing patterns (cognitive maps) from individuals (Howick, Eden, Ackermann, & Williams, 2008). Similarly, DeLano (1998) recommends interviews to conduct patterns from experts about how a system works.

The interviews were designed to collect narratives to allow the extraction of cognitive maps and patterns (DeLano, 1998; Howick, et al., 2008; Miles & Huberman, 1994, pp. 143-171). Based on the patterns the system model can be designed (Howick, Ackermann, Eden, & Williams, 2009). This permitted the modelling of the 'soft' system model of the context within interactions between individuals (process view) in relation to creativity as described by Checkland & Scholes (1999).

For the collection of in-depth contextual data, a thirty to forty minute, one-to-one interview or small group interview was executed. These interviews comprised semi-structured and open questions, which permit free association. Hollway & Jefferson (2008, pp. 314-315) stated this as follows:

> "[...] the psychoanalytic principle of free association, which assumes that unconscious connections will be revealed through the links that people make if they are free to structure their own narratives. This adds a further dimension to the principle of preserving the whole of the account, rather than breaking it down into parts. The 'form' or gestalt reveals the unconscious dynamics which structure memory and hence a person's subjective investment in their past actions and experiences." (Hollway & Jefferson, 2008, pp. 314-315)

The semi-structured interview design with open and follow-up questions allowed the participants to say more in the answer than required (Liamputtong, 2009). Semi-structured interviews have some structure, which can vary depending on the design (Robson, 2011, pp. 285-287). The open question and follow up design allowed a very flexible design depending on the emergent respondents and accounts by the interviewee and interview situation. The semi-structure design incorporated therefore some basic main questions, which allowed the interviewee to bring up any relevant construct from their past experience (Gilbert, 2008, pp. 246-247; Rubin & Rubin, 2005, pp. 158-159). This approach of a loose structure was designed to allow interviewees to speak freely in their own words. Emergent themes were followed up in an inductive manner. The disadvantage of this loose structure and open questions design is that the data collection resulted in a very large data set, which was difficult to analyse (Miles & Huberman, 1994, p. 17).

Furthermore, interviews need to be designed to minimise interviewer bias such as notice of evidence that supports opinions of researchers' and the influence of the interviewer's skills (Kvale & Brinkmann, 2009, p. 213). Therefore, the interview design incorporated some steps of the best practice approach as advocated by Kvale & Brinkmann (2009, pp. 81-95). The first one is practising interviews through pilot interviews. This included practice, reflection and improvement of the formulation and sequence of questions, which allowed reflection and re-structure of an interview. As the interviews included open and follow-up questions, each interview differed in its structure. This design includes actively listening to what the interviewee says and an intuitive skill to continue the interview in a fruitful way (Kvale & Brinkmann, 2009, pp. 138-141). Mutual understanding of the interviewees' accounts was designed through repetition of the account by the interviewer in his own words. This allowed the interviewee to reflect on the interviewer's understanding and to correct it within the interview.

Furthermore, for the validity of the interview data, the interview questions were designed in such a way that they can be asked in a straightforward manner to minimise the influence of the interviewer through the elimination of 'cues' as advised by Robson (2011, p. 282). The limitations of the interview method were, firstly the limited generalisability, as situations and individual factors made it difficult to draw general conclusions. Secondly, interviews were influenced by subjectivity and thirdly, the interviewer's interview skills influence the way data is managed. These limitations were stated by Fielding & Thomas (2008). Generalisability is only given in a similar context as design patterns allow the communication of context-specific problems and solutions as discussed by Rising (1998b).

Nevertheless, the interview method allowed the collection of complex patterns from the experience of individuals. This provided holistic and contextually rich data from personal experience (Chase, 2011). Additionally, the open question design permitted researchers to firstly overcome self-referentiality of pre-existing theory and to elaborate a new theory from emergent constructs (Dubois & Gadde, 2002). Secondly, it allowed data subjects to describe the phenomenon in their own narratives and full account. The negative consequence was that it resulted in a very large and complex data set, but allowed the critical reflection of the focus group data and added context for a fully formed explanation.

### 4.5.4 *Conclusion to research methods*

This section evaluated the design of the methods that allow modelling the 'hard' and 'soft' system model. The mixed methods adopted allowed a multi-level analysis of the organisational context through a quantitative questionnaire and the local context through qualitative focus groups and interviews. These methods were used to collect data from the case study organisation.

## 4.6 The field work

The data was collected from a single in-depth case study organisation, Daimler AG. The case study organisation was acquired between March 2007 and November 2007 and data was collected from November 2007 to December 2008. During this time the researcher conducted quantitative and qualitative data, while working within the organisation. This allowed the researcher to be involved within the case organisation as recommended by Flyvbjerg (2001).

### 4.6.1 *Practitioners' interest in the topic*

Several organisations were contacted in mid 2007 to discuss potential research project investigations. Through the researcher's past work experience at DaimlerChrysler AG (now Daimler AG) contact was arranged and meetings were held to discuss possible research collaboration. At these meetings, it was established that the research project would fit into a particular project at Daimler AG. This project incorporated the design of a system that facilitates problem identification, problem solving and idea creation. A research student contract at Daimler AG over a 12 month period was agreed, which was extended for another 2 months. This allowed an in-depth investigation at Daimler AG of fourteen months from November 2007 to December 2008.

### 4.6.2 *Daimler AG*

Daimler AG is one of the key players in the automotive manufacturer industry. Daimler AG is a global company and known worldwide for its premium, luxurious automobiles. The company's history is based on the inventors Gottlieb Daimler (1834 - 1900), who invented, together with Wilhelm Maybach (1846 - 1929), the first internal-combustion engines and Karl Benz (1844-1929), who is recognised as the inventor of the modern automobile. The two companies of Daimler (Daimler Motoren Gesellschaft AG) and Benz (Benz & Company) merged to form Daimler-Benz AG in 1926 and merged with Chrysler in 1995 to form DaimlerChrysler ("Company History in Brief," 2012). In 2007, at the beginning of the research project, the merger ended and the company now operates under Daimler AG.

Daimler AG has its headquarters in Untertürkheim, Stuttgart and incorporates five business units as presented in Table 4-5 (next page). The main units involved in this research were Mercedes-Benz Cars and Daimler Trucks. The area of research conducted was in the region of Stuttgart, which incorporated the headquarters in Untertürkheim, the main production plants for cars in Untertürkheim and Sindelfingen, the Mercedes-Benz technology centre (MTC) in Sindelfingen and the, global sales and marketing and business administration in Möhringen.

The organisation itself is organised using a committee structure with different hierarchical levels. The hierarchy incorporates the boards of management (A and B level), president (E1), director (E2), senior manager (E3), team manager (E4), and employee levels (E5 and SB).

| Business unit | Brands | Employees figures (2011) | Key products | Sales units (2011) |
|---|---|---|---|---|
| **Mercedes-Benz Cars** | Mercedes-Benz | 99,091 | A-Class, B-Class | 192,300 |
| | Smart | | C-, CLK-, SLK-Class | 411,800 |
| | Maybach (2011) | | E-, CLS-Class | 340,100 |
| | | | S-, CL-, SL-Class, SLR, SLS, Maybach | 80,700 |
| | | | M-, R-, G-, GL-, GLK-Class | 254,300 |
| | | | Smart | 99,700 |
| **Mercedes-Benz Vans** | Mercedes-Benz | 14,889 | Viano | 264,200 (total) |
| | | | Vito | |
| | | | Sprinter | |
| | | | Vario | |
| **Daimler Trucks** | Mercedes-Benz | 77,295 | Atego, Axor, Actros, Econic, Zetros, Unimog, Accelo | 425,800 (total) |
| | Freightliner | | | |
| | Fuso | | | |
| | Western Star | | Business Class, Cascadia, Coronado | |
| | Thomas Built | | | |
| | Busses | | 4700, 4800, 4900, 6900 | |
| | BharatBenz | | | |
| | DetroitDiesel | | Type A, Type C, Type D | |
| | | | Canter, Fighter, Super Great, Rosa, Aero Star, Aero Queen, Aero Ace | |
| **Daimler Busses** | Mercedes-Benz | 17,495 | City busses, Coaches, Interurban Busses, Travego, Interurban minibuses, travel minibuses, city, minibuses, mobility minibuses, | 39,700 (total) |
| | Setra | | Setra coaches, Setra Interurban busses | |
| | Orion | | Orion city busses | |
| **Daimler Financial Services** | Mercedes-Benz Bank | 6,742 | - | - |

**Table 4-5: Daimler AG company profile ("Business Units," 2012)**

### 4.6.3 *Innovation management at Daimler AG*

The innovation management at Daimler AG incorporates three main areas namely, (1) strategy and innovation, (2) research and advanced development and (3) business innovation. Strategy and innovation is responsible for the direction of future innovative technologies. They use techniques such as innovation road-map, society research and future technology trends research. The research and advanced development are responsible for generating new innovative ideas within the given strategic direction. Business innovation is an interdisciplinary team from all business functions of the organisation with the focus of generating new ventures and new profitable business models. One project of the Business Innovation team is the Car2Go venture. This department has institutionalised a Business Innovation Community, an internal and open online idea platform. Overall there are several different initiatives, techniques, methods and processes used to drive creativity and innovation.

The innovation process at Daimler AG incorporates several main phases (as presented in Figure 4-5).


**Figure 4-5: Simplified linear innovation process / product cycle at Daimler AG (internal document)**

Each phase has different innovation initiatives. For example, the research & advanced development phase incorporates a specific organisation to explore new innovation. This phase incorporates project teams within specific strategic 'theme fields' (for example alternative drive systems or safety systems). These 'theme fields' are an open direction to explore and develop new innovation. This exploration of innovation is supported by an 'innovation workshop' that guides interdisciplinary teams through the creative process.

The module strategy, product development and mass production / product maintenance phases for, for example, Mercedes-Benz Cars incorporates thirteen phases and functions as presented in Table 4-6.

| Phase | New automotive product development |
|---|---|
| 1 | Market research |
| 2 | Concept phase |
| 3 | Specification phase |
| 4 | Design |
| 5 | Development |
| 6 | Test phase power train |
| 7 | Prototype |
| 8 | Testing phase |
| 9 | Test drive phase |
| 10 | Test of mass production |
| 11 | Mass production |
| 12 | Sales & Marketing |
| 13 | After Sales |

**Table 4-6: New automotive product development (internal document)**

New product development takes around six to eight years. Each automobile consists of several modules such as power train systems, light systems, exterior, interior, suspension systems and the steering system to name a few. Each of these modules is developed by project teams, which consist of team members from different business functions throughout the company. This highly complex organisation of several functions within multiple modules is supported by several organisational systems as follows:

- Mercedes-Benz Development System (MDS)
- Mercedes-Benz Production System (MPS)
- Mercedes-Benz Marketing System (MMS)
- Mercedes-Benz Quality System (MQS)
- Mercedes-Benz After Sales System (MAS)

These systems provide structured processes for an integrated new product development. This allows development of modules, which are integrated into an automobile. The value-creation as well as problem identification and solution generation is supported by specific processes and workshops.

The research focused on the technical functions and departments and their business administration such as research, advanced development, development, quality, production, planning, marketing, controlling and after sales and, in particular, innovation management.

### 4.6.4 *Data collection*

The data collection at Daimler AG incorporated three main phases, namely the, (1) preparation phase, (2) quantitative data collection and (3) qualitative data collection.

#### *4.6.4.1 Preparation phase*

The preparation phase took place between November 2007 and February 2008. This phase incorporated becoming familiar with the project and organisational environment, examining the structure and processes of the organisation and observing the functions, departments and processes within the organisation and defining the boundaries and feasibility of the research. This phase is illustrated in Figure 4-6.

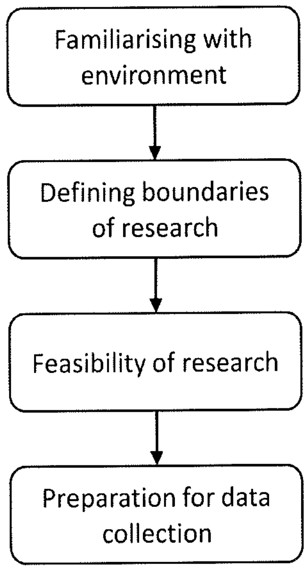



**Figure 4-6: Process of preparation phase of data collection**

This phase included conversations and corporate document basic analysis, which led to the second phase of quantitative data collection.

#### *4.6.4.2 Quantitative data collection*

The next phase was the quantitative data collection, which took place from February 2008 to July 2008. This phase included the design, sampling and execution of the questionnaire survey. The process of this phase is illustrated in Figure 4-7.

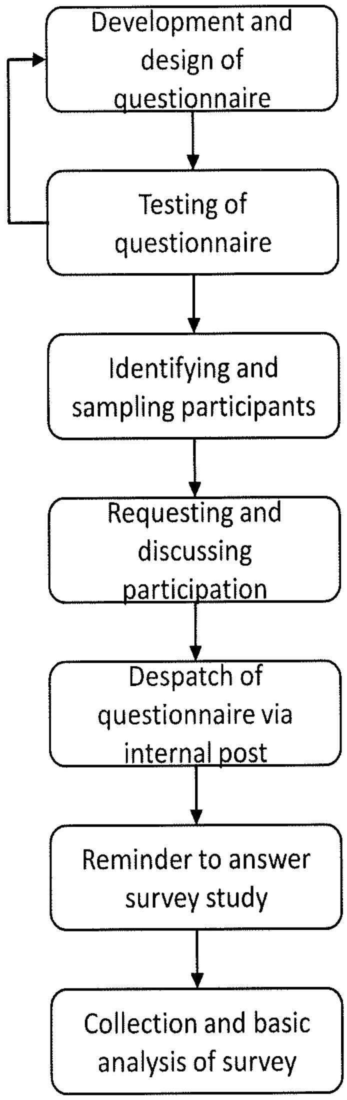



**Figure 4-7: Process of quantitative data collection phase**

First step of the data collection process as presented in Figure 4-7 was the development and design of the questionnaire. This included theme selection of key concepts ('intellectual bins'), identification of key variables and development of questionnaire statements (literature review) and the definition of time horizons and boundaries for the survey as advocated by Sterman (2000, p. 86). The design of the survey study was described in detail in section 4.5.1 (page 128).

The second step was to test the questionnaire. The questionnaire was tested by a very small number of test persons within Daimler AG. This feedback led to redevelopment of the questionnaire (step one).

Thirdly, the identification and sampling of relevant participants was executed. Several of the sampling strategies identified by Teddlie & Yu (2007) might have been appropriate. The sample strategy adopted was a probability strategy to provide good representation of the population. The business functions involved in the quantitative data collection were the engineering orientated functions and their business administration that are responsible for new car and truck development. The intention of this survey was to collect data from multiple departments and functions involved in the complexity of creating and developing innovation at Daimler AG. However, the complexity was reduced as it was not feasible to question each department of each function involved. Therefore, the sample size that was practical for the limited was adopted as recommended by Miles & Huberman (1994, pp. 27-30).

The identified departments were contacted via email in which the research project, purpose and survey was described. This followed discussions and agreement of participation for those departments that, wanted to participate. Full anonymity of the data subjects was promised and provided. Completed questionnaires were sent back directly by the data subjects. Furthermore, it was promised that no department and business function comparison of the data set would be executed.

Around ten questionnaires were sent to each identified department office. This had the limitation that the several participants were chosen by each department office. The questionnaire was sent via internal mail to each department. The survey also incorporated a feedback sheet, which allowed each participant to provide feedback about the survey. The main feedback given was that it had 'too many questions'.

The participants had three weeks to fill out the questionnaire and send it back via internal mail. Reminder emails were sent to each department after one week and again in the second week.

Lastly, each filled out questionnaire was sent back to the office of the department to which the researcher belonged. Each questionnaire was given an ID and answers were digitalised into a SPSS data set, which allowed demographic analysis. The data collection resulted in a response rate of 62.81 %, which corresponds with 201 completed questionnaires out of 320 questionnaires. The demography of the survey measured consisted of three dimensions; the department, business unit and the hierarchical level as presented in Table 4-7.

| Respondent Profile | Frequency (n=201) | Percentage (%) | Accumulative percentage (%) |
|---|---|---|---|
| **Department** | | | |
| After Sales | 41 | 20.4 | 20.4 |
| Development | 82 | 40.8 | 61.2 |
| Development Quality | 2 | 1.0 | 62.2 |
| Quality | 34 | 16.9 | 79.1 |
| Production/ assembly | 26 | 12.9 | 92 |
| Production planning | 5 | 2.5 | 94.5 |
| Prototype assembly | 6 | 2.99 | 97.49 |
| Not answered | 5 | 2.5 | 100 |
| **Business unit** | | | |
| Mercedes-Benz Cars | 168 | 83.6 | 83.6 |
| (PC) | 10 | 5.0 | 88.5 |
| Both (PC and CV) | 13 | 6.5 | 95 |
| Daimler Trucks (CV) | 10 | 5.0 | 100 |
| Not answered | | | |
| **Hierarchical level** | | | |
| Director or higher (E2 or | 3 | 1.5 | 1.5 |
| higher) | 20 | 10 | 11.5 |
| Senior Manager (E3) | 71 | 35.3 | 46.8 |
| Team Manager (E4) | 95 | 47.3 | 94.1 |
| Employee (SB) | 12 | 6 | 100 |
| Not answered | | | - |

**Table 4-7: Demographic analysis – organisational learning and creativity survey**

An examination of the data relating to the demographic profile of respondents revealed that the majority (40.8 %) were within the development function. After Sales accounted for 20.4 % of the sample size and Quality represented 17.9 % of the sample. Prototype Assembly, Production and Production Planning had a quota of 18.39 % (12.9 % + 2.5 % + 2.99 %).

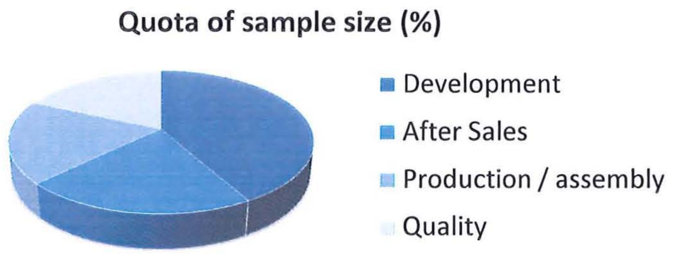



**Figure 4-8: Departmental quota of organisational learning and creativity survey**

The second dimension of the survey revealed the emphasis of the personal vehicle (PC) unit with 88.6 % employees responsible for the development and sustainment of Mercedes-Benz Cars. Employees responsible for Daimler Trucks (CV) were represented in the sample with a quota of 11.5 %, while 5 % remain unknown.

The hierarchical dimension consists of a ratio 47.3 % of the operational working force and a ratio of 46.8 % (1.5 % + 10 % + 35.3 %) of the managerial working force. Managers account for approximately half of the sample size, whilst approximately the other half was represented by operational employees. Therefore, the sample represented the managers as well as the operative working employees equally. The managerial workforce can be categorised in purely strategic management as Directors or higher with the ratio of 1.5 %, middle management with 10 % (senior managers) and team management with the ratio of 35.3 %. The implication of this sample size was that the emphasis of the survey result was on team management and the operational workforce.

The quantitative data collection accumulated a data set that allowed investigation of the shared behaviour and conditions that represented the complexity of the organisation to develop, produce and maintain the key products; Mercedes-Benz Cars and Daimler Trucks. The next phase was the qualitative data collection, which was collected to investigate the individual and group perspective in relation to creativity at Daimler AG.

#### *4.6.4.3 Qualitative data collection*

The qualitative data collection phase from June 2008 to December 2008 included sampling, designing, testing and executing the focus group discussions and interviews. This qualitative data collection followed the process as illustrated in Figure 4-9.

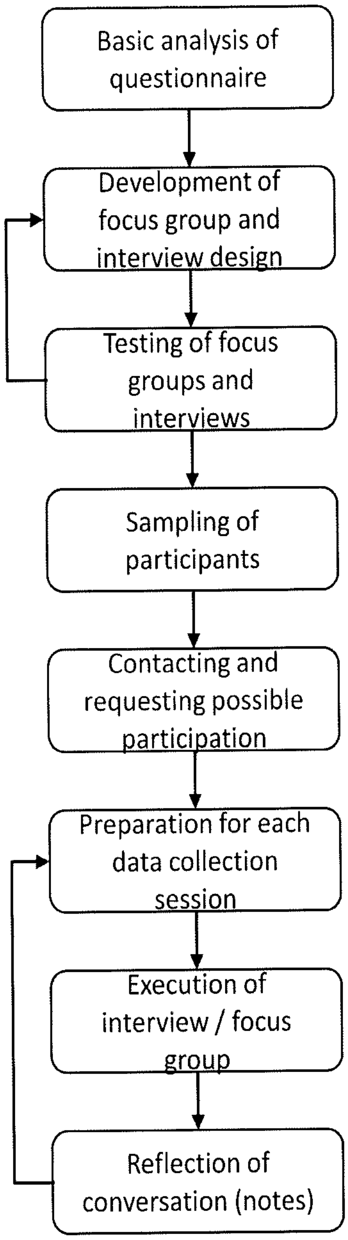


**Figure 4-9: Process of qualitative data collection**

The first step of this process was the basic analysis of the collected survey data, which revealed the key variables with the highest Pearson's correlation coefficient (relationship) with the (1) innovation performance for each 'intellectual bin'. The analysis of the data will be discussed in section 4.7 (page 150). These key variables were used for the focus group discussions.

The second step included the focus group and interview designed as described in detail in section 4.5.2 (page 130) and section 4.5.3 (page 132). The focus groups design followed the 'intellectual bins' with each key variable are presented, while the interviews were constructed including the 'intellectual bins', but allowing other themes to emerge. These designs were tested.

Thirdly, the focus groups were tested by a group within the case organisation with similar settings to the focus groups conducted. Similarly, the interview design was tested by an internal test person. This allowed feedback and reflection, which led to improvement of the interview design and performance and allowed familiarisation with the focus groups and interview situations.

The sampling of the focus groups and interviews were executed. The sampling was based on a purposive sampling technique (Kemper, Stringfield, & Teddlie, 2003, p. 278; Teddlie & Yu, 2007). This strategy was chosen to achieve a high probability in examining situations in which creativity was facilitated and emerged from experience of the data subjects. Therefore, the data subjects chosen for the focus groups were engineers responsible for innovation and development of the passenger car and truck. Similarly, interview subjects were chosen who were either responsible for the creation of new innovative concepts or responsible for supporting the creation of new innovative concepts (innovation management). This purposive sampling has been recommended by DeLano (1998). These experts were identified and contacted though an analysis of the corporate intranet and by selecting participants from the questionnaire survey. The list of experts responsible for innovation within Daimler AG was elaborated through an intranet search of the word "innovation" and "creativity" within their job description, responsibility and experience. The list of interviews conducted can be found in Appendix D (page 373).

Individuals were contacted via email to firstly provide the results of the survey study and request an interview and, in two cases, to provide focus groups. Meetings were arranged on a suitable date and time for the data subject. In total, eighty requests were sent out and forty six interviews and two focus groups were conducted.

Before each data collection session, the interviews and focus groups were prepared. This included identification of the task, responsibility, job descriptions and experience of data subject. The information was gathered through the internal intranet. This information was used to adjust the semi-structured interview questions. It is important to state that the interviews were kept very open and unstructured to allow new themes to emerge.

The execution of the qualitative data collection incorporated two parts: (A) focus groups; (B) interviews.

(A) The focus group discussions incorporated three phases. The first phase was the opening phase. This phase involved introducing the project, purpose and aim of the research. The second phase incorporated the presentation of the organisational variables that determine the organisational innovation performance. The key variables (findings of survey study) were presented for each 'intellectual bin' (see research framework on page 125). For each section, the following questions were asked to start the conversation:

- Do these variables facilitate creativity and innovation?
- If so, why and how do these variables enable individuals to be creative within the organisation?

This stimulated the group discussions and allowed examination of how organisational context leads to the process of individual interactions and context that allows creativity to emerge. Furthermore, the groups intuitively stated related variables that build the contextual patterns to facilitate creativity. The last stage of the focus group was a very short final statement and description of further steps of the research project.

The first focus group members critically discussed the organisational context in relation to their interactions and creative performance. The observed effect in the first focus group was that hierarchy had an impact on their interaction and response. Nevertheless, critical discussion, disagreement and open discussions occurred within the conversations between the members with different hierarchies. This showed that open speech, disagreement and open dialogue are practised values within the group. Some of the participants, especially the ones who had been interviewed beforehand, did not participate in the discussion. This might have been that they thought they had already stated their opinion. The second focus group had an open discussion in which every participant contributed. In this group no hierarchical dominance existed. Both groups discussed openly the topics from their group and individual views and experience. A demographic analysis of the focus groups is presented in Table 4-8.

| Focus group | Participants | Recorded minutes | Date & time |
|---|---|---|---|
| **<u>Focus Group 1</u>** | 10 | 31.40 | 21. November 2008 (morning) |
| **Mercedes-Benz Cars** | | | |
| Director | 1 | | |
| Senior Manager | 6 | | |
| Team Manager | 3 | | |
| Employee | 0 | | |
| **<u>Focus Group 2</u>** | 8 | 40.00 | 01. December 2008 (afternoon) |
| **Daimler Trucks** | | | |
| Director | 0 | | |
| Senior Manager | 7 | | |
| Team Manager | 1 | | |
| Employee | 0 | | |

**Table 4-8: Demographic analysis of the focus groups**

(B) Interviews were conducted in the interviewees' offices, meeting rooms or coffee corners. The interview process incorporated the opening phase, question phase and closing phase. The opening phase included explaining the research project and purpose and giving a brief overview of the survey conducted. The main phase included asking open questions related to the 'intellectual bins' (research framework) and follow up questions such as "how are great ideas developed within your department or project? ", "how can a leader support the creation of new and valuable ideas?" or "which interactions between individuals can facilitate idea generation?" Questions were asked in the context of the specific work and job descriptions. This allowed the interviewee to answer the questions in the context of their own work and experience.

Interviewees were asked for their permission to record the interviews. Five out of forty- six interviews were not tape recorded and were recorded using pen and paper. In these five interviews, a lot of information was lost. The total recorded time was 31 hours and 33 minutes (1893.27 minutes). The average recorded minutes per interview was 41.16 minutes. The demographics of the data subjects of the interviews are presented in Table 4-9.

| Respondent Profile | Frequency (n=46) | Percentage (%) | Accumulative percentage (%) |
|---|---|---|---|
| **Departments:** | | | |
| **Innovation management** | | | |
| Inno. mgmt (R&AD) | 9 | 19.57 | 19.57 |
| Strategic inno. mgmt. | 2 | 4.35 | 23.91 |
| Market & customer research | 2 | 4.35 | 28.26 |
| Business innovation | 1 | 2.17 | 30.43 |
| Controlling – innovation | 1 | 2.17 | 32.61 |
| **Core business functions** | | | |
| Development | 14 | 30.43 | 63.04 |
| Production | 4 | 8.7 | 71.74 |
| After Sales | 5 | 10.87 | 82.61 |
| Quality | 6 | 13.04 | 95.65 |
| Design | 1 | 2.17 | 97.83 |
| Information technology | 1 | 2.17 | 100 |
| **Hierarchical levels:** | | | |
| Director | 5 | 10.87 | 10.87 |
| Senior Manager | 22 | 47.83 | 58.7 |
| Team Manager | 9 | 19.57 | 78.27 |
| Employee | 10 | 21.74 | 100 |

**Table 4-9: Demographic analysis of the data collection of the interviews**

Lastly, after each data collection session, basic notes were taken and reflections recorded on the interview and the focus group sessions. This influenced the next set of interviews. The summary of the reflections showed that the interviewees had a high level of openness. The way that they addressed problems and issues related to creativity and innovation in a very straightforward manner was surprising. This might be related to the German culture, as it is often seen to be very direct. Interviews ranged from very critical interviews to interviews without criticism. In some cases informal discussions were followed up after the interview, which allowed more insights to be gathered. Interviewees were asked, if these conversations can be used and were noted using pen and paper after the conversation.

### 4.6.5 *Conclusion of field work*

The field work at Daimler AG permitted the collection of in-depth data about the context (influential factors) at multiple levels, so that system models could later be built. These models then provided an explanation of the dynamic and emergent complexity of creativity and innovation in the case study organisations. The field work conducted allowed the research to be placed within the phenomenon studied, as advocated by Flyvbjerg (2006). This permitted the collection of a data set, which represents the inherent dynamics and complexities within the organisation to facilitate creativity and innovation. It allowed an analysis of different sub-units and an holistic analysis. The contract at Daimler AG and main data collection period ended after fourteen months in December 2008. The data collection followed by transcribing and analysing collected data and modelling the system models.

## 4.7 Data analysis and system modelling

The collected data was transcribed onto a SPSS data sheet (quantitative data) and into text files (qualitative data) used for an Nvivo analysis. These software packages allowed investigation of the collected data. This section discusses the data analysis process, techniques of analysis used and the 'hard' and 'soft' system modelling processes.

### 4.7.1 *Quantitative analysis and 'hard' system modelling*

The first step in the data analysis was exploration of the data. The software packages SPSS 16 / PWAS 18 allowed the exploration and analysis of the data set. The data was analysed for each section of the questionnaire ('intellectual bins') as presented in Table 4-10.

| Construct being measured | 'intellectual bins' (sections) |
|---|---|
| Factors of organisational context | (B) Information and explicit knowledge<br>(C) Implicit knowledge<br>(D) Vision and leadership<br>(E) Behaviour and climate<br>(F) Structure and workplace<br>(G) Resources<br>(H) Infrastructure and communication<br>(I) Knowledge creation routines<br>(J) Creativity routines |
| Factors of organisational innovation performance | (K) Innovation performance |

**Table 4-10: Construct being measured in each 'Intellectual bin'**

#### *4.7.1.1 Analysis techniques*

There are two main analysis techniques used in this study:

(I) Confirmatory factor analysis (CFA)

(II) Pearson's correlation coefficient analysis (PCA)

The CFA permitted the understanding of the structure of the data set, measurement of underlying dimensions and reduction of data to a manageable size (Field, 2005, p. 619). The PCA was used to reveal the correlation coefficient (relationship) between the factors.

(I) CFA techniques used to identify the organisational factors and the organisational innovation capability factors. Field (2005) provides a guid to the CFA and Fabrigar, Wegener, MacCallum, & Strahan (1999) state several concerns, which needed to be taken into account. These steps and concerns and the appropriate methods and techniques used are presented in Table 4-11.

| Concern | Technique used | Reasons |
|---|---|---|
| Factor extraction method | Maximum likelihood | - The data is relatively normally distributed<br>- Allows goodness-of-fit statistics<br>- Statistical significance testing of factor loading and correlation among factors<br>(Fabrigar, et al., 1999, p. 277) |
| Number of factors retained | (1) Kaiser (1960) criterion<br><br>(2) Scree plot methods | (1) Used when sample size > 250 and average communalities > 0.7<br>retaining all factors with eigenvalue > 1.0<br>(Field, 2005, p. 633)<br><br>(2) Identification of the point of inflexion) and sample size min two hundred items<br>(Osborne, Costello, & Kellow, 2008; Stevens, 2002) |
| Rotation | Promax rotation | Orthogonal rotations produce factors that are uncorrelated, while oblique methods allow the factors to correlate.<br>(Field, 2005, pp. 634-636) |
| Sample size for using a CFA | Kaiser-Meyer-Olkin (KMO) measure | Allows the estimation of distinct and reliable factors yield by the CFA with the values of<br>- 0.5 and 0.7 = mediocre<br>- 0.7 and 0.8 = good,<br>- 0.8 and 0.9 = great<br>- above 0.9 = superb<br>(Field, 2005, p. 640) |
| Retention of variables | (1) Item-total correlation test<br>(2) Squared multiple correlation analysis (SMC) | (1) Allows the measuring of inconsistency of the single item with the averaged item of all variables used.<br>(2) Identifies variables that do not measure the same construct.<br>(Field, 2005, p. 630) |
| Model fit to observed data | Goodness-of-fit statistics | Allows measuring how well the data predicted by the model corresponds with the conducted data. Accepted significant level within the social science:<br>- above 95% ($p < 0.05$)<br>(Field, 2005, pp. 25, 27-28) |
| Factor reliability | Cronbach's $\alpha$ | Calculates the variance within the item and the covariance between a particular item and any other item on the scale.<br>The thumb rule in social science :<br>- > 0.9 = excellent,<br>- < 0.9 = good,<br>- < 0.8 = acceptable,<br>- < 0.7 = questionable,<br>- < 0.6 is poor<br>- < 0.5 is unacceptable<br>(Field, 2005, p. 667; George & Mallery, 2009) |

**Table 4-11: Analysis techniques used for CFA**

First concern presented in Table 4-11 is the factor extraction methods used. Maximum likelihood was adopted as it is the best factor extraction method when the data is relatively normally distributed, because it allows computation of goodness-of-fit statistics of the factor model, statistical significance testing of factor loading and correlation among factors as argued by Fabrigar, et al. (1999, p. 277).

The next concern within the CFA was the number of factors retained (Field, 2005, pp. 632-634). The factor extraction method used was the scree plot method. The scree test involves examination of the eigenvalue graph and identification of the point of inflexion as recommended by Osborne, Costello, & Kellow (2008). Stevens (2002) argued that more than two hundred participants are needed for the scree test. The number of participants of the survey was two hundred and one (N=201).

The third concern is the rotation of the factor. The question relating to this concern is whether the resulting factors should be related or independent? The assumption is that the factors of an organisation interrelate. Therefore, promax rotation (oblique rotation) was used. Also the technique was adopted as there is little difference in the outcome when using different oblique rotation techniques (Fabrigar, et al., 1999).

The fourth concern was the sample size for using a CFA. The Kaiser-Meyer-Olkin (KMO) measure allows the estimation of distinct and reliable factors yielded by the CFA. The resulting KMO values of all factors were between mediocre (0.5) and great (0.8).

The fifth concern was the retention of variables within the analysis. The item-total correlation test allowed the measurement of inconsistency in the single item with the averaged item of all variables used (Field, 2005). The second method to identify variables that do not measure with the same construct or underlying dimension was the squared multiple correlation analysis (SMC) (Field, 2005, p. 630). SMC analysis measures the total variance for a particular variable (communalities) (Field, 2005, p. 630). All variables with a communality value below the value of approximately 0.3 were deleted from the analysis due to the lack of common variance as recommended by Field (2005).

The goodness-of-fit statistics is an index of how well the statistical model of the factors fits with the conducted data, from which it was generated (Field, 2005, p.

732). This allows researchers to measure how well the data predicted by the model corresponds with the conducted data. Each model of the factors had a good fit ($p > 0.05$) apart from the (D.I) leadership style factor and (D.II) vision communication (Goodness-of-fit: df:13, Chi-Square:41.125, $p$:0.000). Further analysis revealed that there were five different leadership styles within the data set. Therefore, the (D.I) leadership style factor represented only 47.69 % of the data. This provided some explanation of the result of the goodness-of-fits test on the (D.I) leadership style factor and (D.II) vision communication. In this study no further investigation had been made about the diverse leadership styles.

The seventh concern is the reliability of the factors, which was tested through the Cronbach's $\alpha$ measurement. Cronbach's $\alpha$ calculates the variance within the item and the covariance between a particular item and any other item on the scale (Field, 2005, p. 667). The reliabilities of the organisational factors are between good and poor, which will be presented in Chapter 5 (page 174).

The confirmatory factor analysis (CFA) allowed the identification of sixteen factors of organisational context and two factors relating to change (innovation and improvement). For the investigation and modelling of the system it was necessary to identify the relationships between the several factors. Relationships between factors were examined through a Person's correlation analysis technique.

(II) PCA technique allowed the measurement of a linear relationship between factors (Field, 2005, pp. 107-142). The use of Pearson's correlation analysis is recommended when the data is normally distributed (Field, 2005, p. 125). Pearson's product-moment correlation coefficient ($r$) is the covariance of two variables (factors) divided by the product of their standard deviations and results in a value between ±1 as presented in Equation 4-1.

$$r = \frac{cos_{xy}}{s_x s_y} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{(N-1)s_x s_y}$$

**Equation 4-1: Pearson's product-moment correlation coefficient (Field, 2005, p. 111)**

A negative value indicates that the two factors have a negative relationship, while a positive value indicates a positive correlation (Field, 2005, p. 111).

| Value | Relationship |
|---|---|
| ±0.1 | Small |
| ±0.3 | Medium |
| ±0.5 | Large |

**Table 4-12: Person's correlation coefficient (Field, 2005, pp. 32-33, 111).**

Pearson's correlation coefficient provides an objective measure of the importance of the relationship between the factors. The technique allowed the identification of the interrelation between the several factors of organisational context and factors of (1) innovation and (2) improvement performance. The correlations matrix can be found in Appendix F (page 376).

The investigation of the relationship between two factors requires a statistical significant test to identify if the relationship occurred by chance. The statistical significance test results in a probability (p-value). The accepted p-value in social science is 95% ($p < 0.05$) (Field, 2005, p. 128). This means that the relationship between the factors do not occur by chance. The relationships with a p-value above 0.05 were dismissed in the analysis. The limitation of the approach was that firstly no direction of causality could be identified (Yin, 2006, pp. 19-20). Secondly, the relationship between factors could be caused by an unmeasured third-factor (Field, 2005, pp. 127-128). The analysis still allowed modelling of the system, but additional factors might influence the relationship within the model and might be needed to facilitate the organisational (1) innovation performance and (2) improvement performance.

#### *4.7.1.2 System analysis and modelling*

The analysis of the quantitative data had two different phases. The first phase was the basic analysis, which was executed between July 2008 and August 2008. The second phase was the detailed analysis including designing the 'hard' system model, which was executed between March 2009 to August 2009.

The basic analysis of the survey data identified firstly, the factor of the organisational (1) innovation performance and secondly, the relationship between the organisational variables and (1) innovation performance as presented in Figure 4-10.

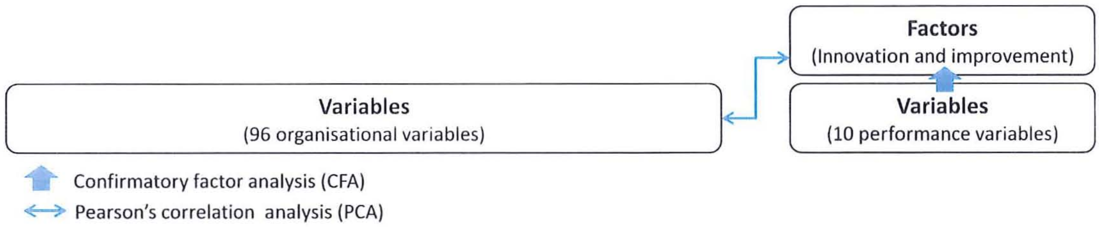



**Figure 4-10: Basic analysis of the quantitative survey data for further investigation through focus groups**

The CFA produced the (1) innovation performance factor, while the PCA examined the relationship. This was executed to present and discuss the findings in focus groups (as discussed in section 4.5.2 on page 130).

The second phase was the detailed data analysis and system modelling. This investigation examined the organisational perspective (macro level) of the system that facilitates (1) innovation and (2) improvement within Daimler AG. The CFA to identify the factors of the organisational context and PCA investigated their interrelations. This analysis process is illustrated in Figure 4-11.

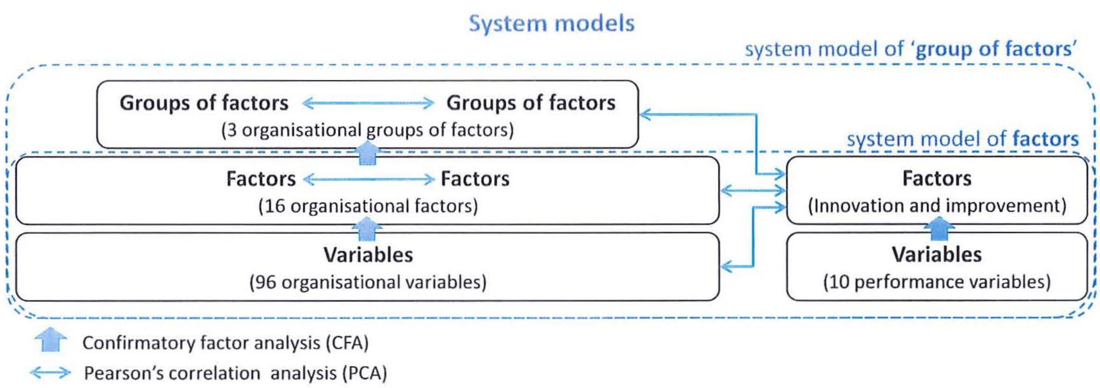
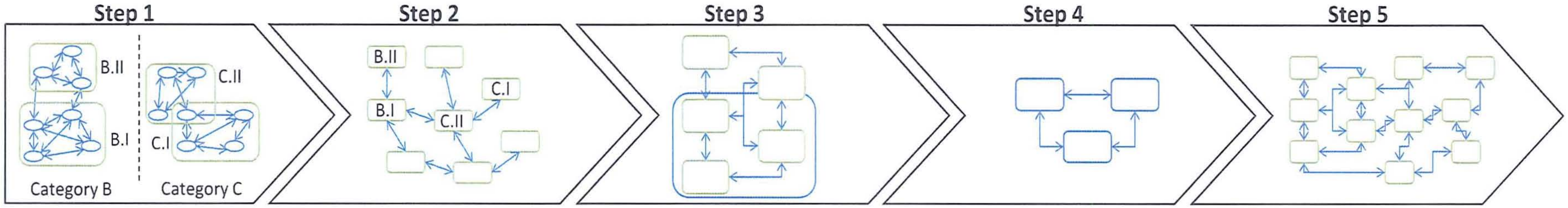



**Figure 4-11: Data structure and analysis of the quantitative data**

The quantitative analysis and modelling process of the 'hard' system model incorporated five steps as presented in Figure 4-12.




1. Identify factors (for each category)
2. Identify relationships between factors
3. Identify groups of factors
4. Identify relationships between factor groups
5. Building the two system models of
(A) Groups of factors
(B) Factors

**Figure 4-12: Data analysis process of the quantitative system investigation (organisational perspective)**

The first building block of the system model was the identification key factors through the CFA. The CFA allowed the grouping of the organisational variables into organisational factors (section B to J) and performance variables into the factors: (1) innovation performance; and (2) improvement performance (section K). The CFA of the organisational variables resulted in sixteen different organisational factors.

The second building block incorporated the identification of the relationships between the factors of organisational context as well as, firstly, (1) innovation performance and, secondly, (2) improvement performance. This was executed through the PCA. Furthermore, this included the identification of the relationships between the sixteen organisational factors through the PCA. This allowed modelling of the system at the 'factor level'.

The third step in the system investigation was the combination of the factors into 'groups of factors' through the CFA. The resulting 'groups of factors' are as follows:

(I) Organisational culture

(II) Information and knowledge management

(III) Organisational design

The fourth step was the identification of the relationships between the 'groups of factors' through PCA. The 'group of factors' were correlated with, firstly, the (1) innovation performance, secondly, (2) improvement performance and, thirdly, with each other to identify their interdependence. This allowed modelling of the system at the level of 'groups of factors'.

The last step in 'hard' system modelling includes mapping the (A) organisational 'group of factors' and (B) the organisational factors into a system model. These system models represent the 'structure' of the large organisational context ('the organisation'). It represents the organisational context in relation to the organisational innovation capacity of (1) innovation (major change) and (2) improvement (incremental change).

### 4.7.2 *Qualitative analysis and 'soft' system modelling*

The qualitative data analysis examined the recorded and transcribed focus group and interview data. This analysis incorporated the identification of key factors and relationships between key factors to map patterns. This approach followed the analysis and model building process of Howick, et al. (2009; 2008) and sensemaking process by Weick (2012) in combination of a pattern mining as discussed by DeLano (1998) and based on the example by Coplien (1998) organisational mapping approach. The data analysis identified patterns, which build a pattern language that expose dynamics that produce spaces. This system model building process incorporates the analysis techniques and several steps as presented in Table 4-13 and presented in Figure 4-13.

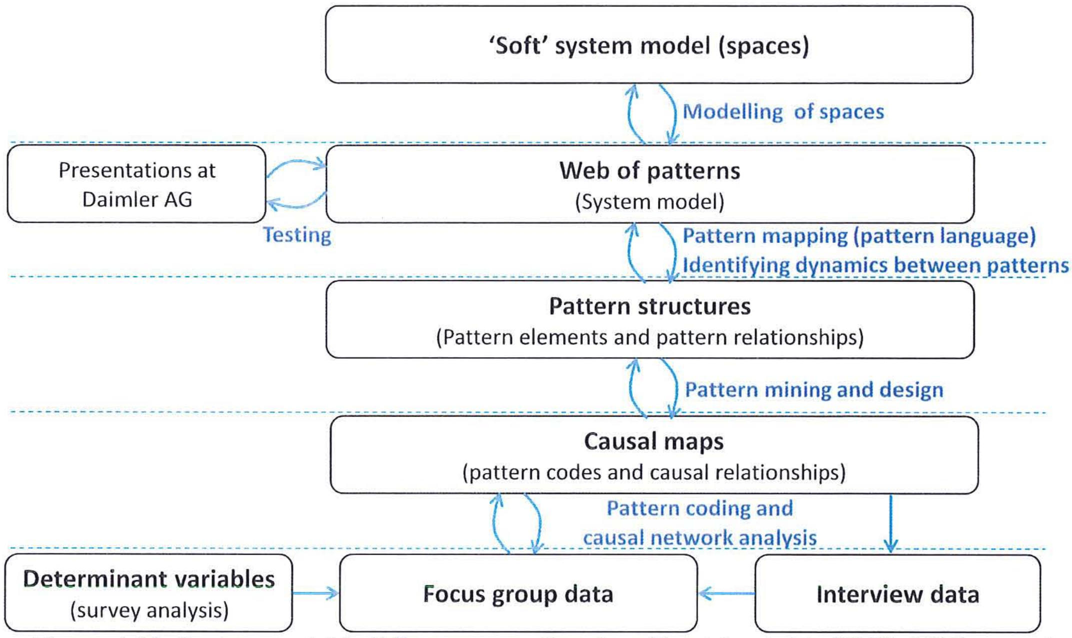



**Figure 4-13: System model building process. Based on Howick, et al.'s (2009; 2008) cascade model building process; Miles & Huberman's (1994) pattern coding and causal network analysis; DeLano's (1998) pattern mining; Alexander, et al.'s (1977) pattern language**

| **Steps** | **Technique used** | **Reasons** |
|---|---|---|
| Narratives codes | Pattern coding | Identification of themes within the data and to be able to compare and contrast different opinions. This is similar to the factor analysis in 'hard' system modelling approaches. (Miles & Huberman, 1994) |
| Identifying relationships between codes | Causal network analysis (cognitive maps) | Identification of relationships between discrete bits of data and building relationship diagrams. (Howick, et al., 2008; Miles & Huberman, 1994) |
| Identification of patterns | Pattern mining | "The mined elements need not be removed as gingerly as a fossil or artefact. The elements must be further processes before it becomes useful. After refinement – cutting, polishing, smelting, modelling – we are left with a useful product." (DeLano, 1998, p. 88) |
| Pattern mapping | Pattern language | The mapping of patterns allowed building a web of patterns (pattern language), with the goal of satisfying the rules within the data. Different pattern arrangements of different patterns can be compared with each other. (Alexander, et al., 1977; Rising, 1998b) |

**Table 4-13: 'Soft' system modelling process through pattern mining**

| Steps | Technique used | Reasons |
|---|---|---|
| Testing | Presentation and feedback | Testing model through participant feedback. |
| 'Soft' system modelling / defining spaces | Sensemaking | Sensemaking is driven by plausibility rather than accuracy and has the goal of interpreting an abundance of data into 'actionable knowledge'. (Weick, Sutcliffe, & Obstfeld, 2012, p. 141) |

**Continuing Table 4-13: 'Soft' system modelling process through pattern mining**

The first analysis technique used was pattern coding. Pattern coding identified key influence factors by chunking and sorting data for each section or category. This was carried out using the NVivo software package. The software allowed the sorting and coding of the data into themes for each 'intellectual bin' (as presented in Table 4-10, page 151). The identified codes were used to analyse the interview data, which allowed a comparison and contrast of different opinions and identification of similarities, contradictions and additional information. The triangulation provided the findings with better empirical grounding (Miles & Huberman, 1994, p. 70).

The second technique used was causal network analysis to reveal cognitive maps (Howick, et al., 2008; Miles & Huberman, 1994, pp. 151-165). Causal network analysis put together the individual's and group's shared mental cognitive maps and make a connection into an evolving network (Howick, et al., 2008; Miles & Huberman, 1994, pp. 152-153). This was executed by piecing together discrete pieces of data into relationship diagrams (Miles & Huberman, 1994, pp. 151-152). Capturing and mapping the mental maps of individuals and groups was a process of constant iteration, continual questioning, testing and refinement, both during data collection and data analysis (Miles & Huberman, 1994, p. 152). This approach allowed generation of an emergent structure of cognitive maps. Each map was based on a fragment of the conducted conversation represented as a map (Howick, et al., 2008). A basic example of a causal map is presented in Figure 4-14.

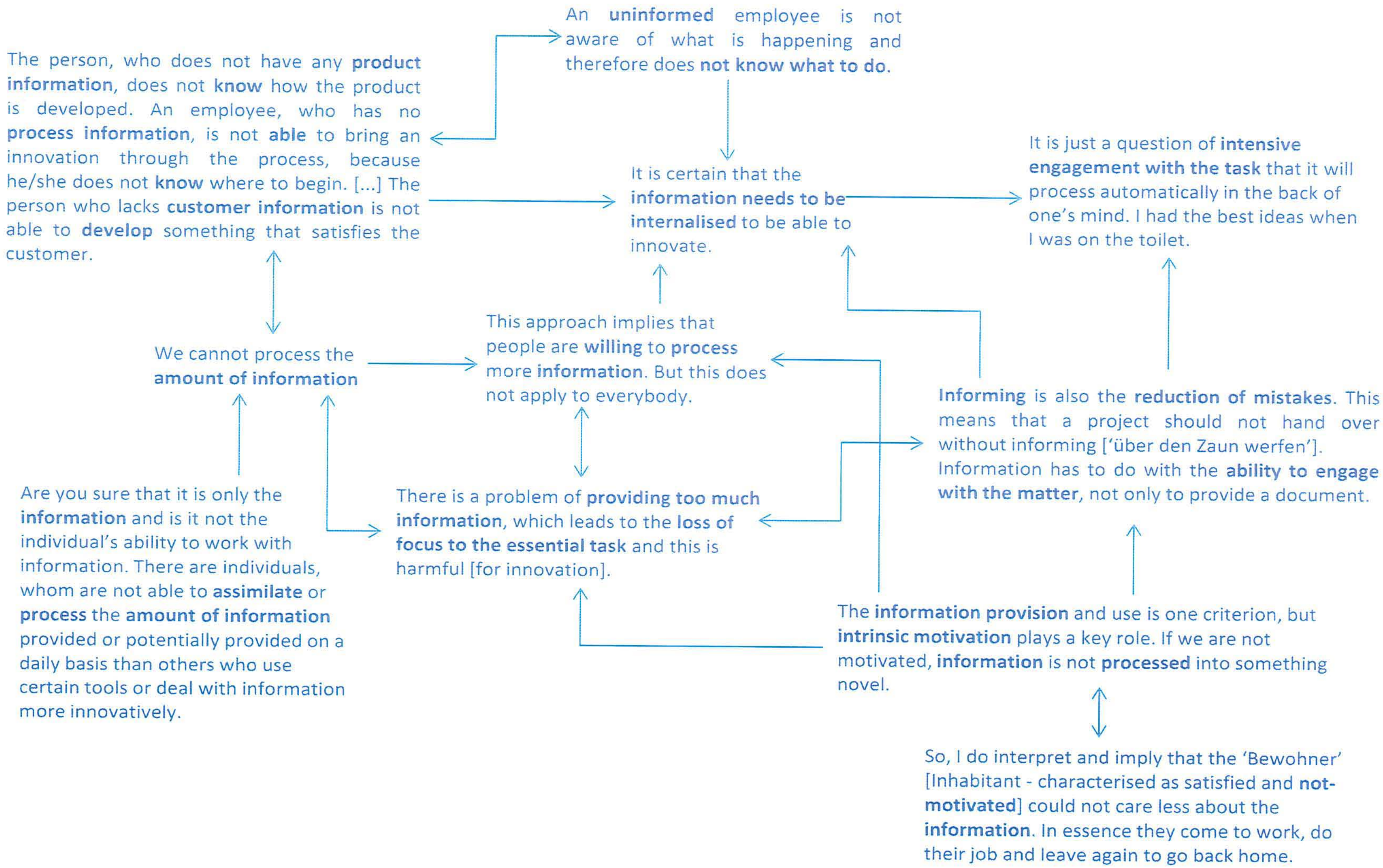



**Figure 4-14: Example of cognitive map**

These causal maps were reduced and re-defined to capture the key factors and essential effects. Howick, et al. (2008) stated in stage two of their model building process that core variables need to be determined and triggers need to be identified. Similarly, DeLano (1998) emphasised that data must be further refined to end up with a useful product. Classifying patterns involves decompressing a pattern into its elements and evaluating the interactions and relationships between these elements (Corfman, 1998). Corfman (1998) stated that this scheme is particularly useful when attempting to identify patterns within an existing system. Pattern mining produces patterns for each section of the research framework. Complex systems have common patterns that manifest themselves. Therefore such patterns help to simplify complex systems (Simon, 1996). The pattern design includes reducing the information by identifying key factors and their causal relationships and structuring them into patterns (DeLano, 1998; Rising, 1998b). An example of a pattern structure is presented in Figure 4-15.

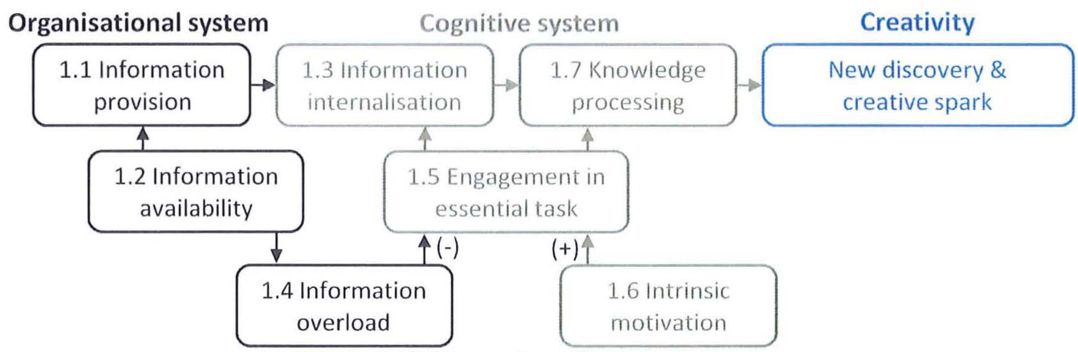



**Figure 4-15: Example of pattern structure**

The third technique used is a pattern language to map the several patterns. Alexander, et al. (1977, p. xiii) emphasised that no pattern is an isolated entity as each pattern exists within a web of patterns. This web of patterns builds a pattern language. The mapping was executed by identifying the interrelations and dynamics between the separate patterns. Adams, et al. (1998) mapped patterns to a pattern map or small pattern language to design a system of telecommunication. Similarly, Coplien (1998, 2006) and Keidel (1995, pp. 99-142) developed an organisational pattern language. Another example is the learning pattern language by Iba, Miyake, Naruse, & Yotsumoto (2009). The mapping of patterns allowed the development of a web of patterns (pattern language). Mapping was executed by identifying interrelations, similarities and coherent dynamic of patterns as exemplified in Figure 4-16.

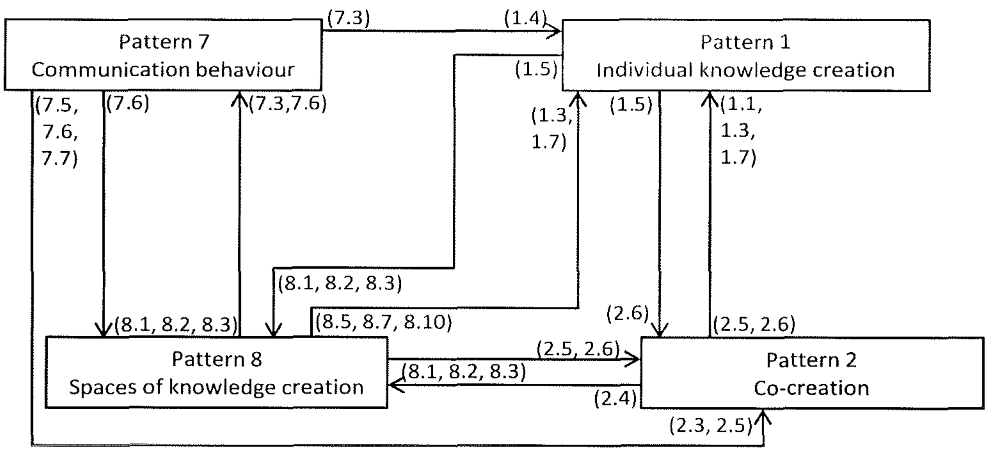


**Figure 4-16: Example of pattern mapping**

As illustrated in Figure 4-16 the pattern language provided rules of pattern arrangements, which are related to creativity in this research, and allowed several possible arrangements which satisfied the rules (Alexander, 1979, pp. 185-186).

The fifth step in the model building process was testing. The 'goodness' of organisational patterns are difficult to test with experiments because of their multidimensional complexity, the difficulty in verifying large scale social experiments, and the issue that experiments would need long-term commitment (Coplien, 1998). Therefore the identified dynamics were translated into 'management language' and were presented and discussed at Daimler AG, which provided feedback. The list of presentations can be found in Appendix E (page 375). The presentations were redefined and evolved over course of different discussions. The feedback and discussions at Daimler AG allowed the validation and restructurisation of the system model (web of patterns).

The last step is sensemaking, which includes the interpretation of the findings of several patterns and the modelling of the model of 'spaces'. This model should represent the findings as simply as possible, but not simpler, according to the principle of 'occam's razor', which is a trade-off between theoretical simplification and assumption that are required (Pfeffer, 1997, p. 43). For 'occam's razor' has been discussed by Gibbs (1996). This representation of the patterns through a model has the goal of 'actionable knowledge'. Weick, et al. (2012) describes this as following:

> "Sensemaking is not about truth and getting it right. Instead, it is about continued redrafting of an emerging story so that it becomes more comprehensive, incorporates more of the observed data, and is more resilient in the face of criticism. As the search for meanings continues, people may describe their activities as the pursuit of accuracy to get it right." (Weick, et al., 2012, p. 141)

Therefore, the model aims to provide 'actionable knowledge' to enable the organisation of knowledge, creativity and innovation towards spaces, in which creativity can emerge and in the large context organisations produce innovation.

### 4.7.3 *Conclusion to data analysis and system modelling*

The data analysis of the quantitative data set and the qualitative data set revealed interrelations between several influence factors, which build pattern of context relating to innovation (macro level) and creativity (micro level). Both analyses produced, with their different methodologies system, models, which are recursively interlinked. This linkage is provided through the research framework as each data set was analysed for each 'intellectual bin'. Furthermore, the developed system models provide insights into the context of the large organisational context and local context in relation to creativity and innovation. This allowed development of an autopoietic system model of the organisation of knowledge, creativity and innovation. For the academic strength of the research, the approach and findings from analysis the validity, reliability and limitations were examined.

## 4.8 Validity, reliability and limitations

In this section the validity, reliability and limitations of the research methodology is evaluated. Validity is concerned with the accuracy of the research and consists of the construct validity, internal validity and external validity (Yin, 2003). Reliability deals with the replicability by other researchers and limitation represents the boundaries of the research projects.

### 4.8.1 *Construct validity*

The first evaluation is the assessment of the construct validity. The construct validity deals with the relevance of measures of the phenomena under investigation (Yin, 2003, pp. 35-36).

Yin (2003, pp. 33-36) stated that the construct validity can be evaluated through the use of multiple sources of evidence, establishment of a chain of evidence and review of the case study results by key informants. The multiple sources of evidence were established by investigating the phenomenon using a mixed method approach of a quantitative questionnaire, qualitative focus groups and qualitative interviews from many diverse data subjects within the case organisation.

The logic chain of evidence was established by presenting the clear steps of data collection and analysis, which allow an external observer to trace the steps from conclusion back to initial research questions and vice versa as advocated by Yin (2003, p. 105).

The last concern of the construct validity is the review of results by key informants (Yin, 2003). The findings of the quantitative results have been reviewed by focus groups, while the findings of the qualitative results were presented and discussed by key participants in the research at Daimler AG. As a result, the data had been accurately recorded, without losing factual correctness or inappropriate emphasis in the process of analysis.

### 4.8.2 *Internal validity*

Internal validity is concerned with the consistency of meaning and valid representation of the phenomena within the study. Yin (2003, pp. 33-36) stated strategies of internal validity testing in case study research.

The first test is pattern-matching. The identified themes, groups and patterns had been reflected through triangulation of the data. This construction of validity from multiple sources established correct operational measures for the constructs being studied (Yin, 2003, pp. 33-39). The combination of different methods can be useful as qualitative data can help to understand the rationale of the underlying relationships revealed in quantitative data and vice versa (Eisenhardt, 1989).

Internal validity of the research results was maintained by matching the themes and patterns identified from multiple data sources and different data subjects (Yin, 2003, pp. 116-120). The second test mentioned by Yin (2003, pp. 33-36) is explanation building and addressing rival explanations. The explanation building is an iterative process including revisiting findings with existing theories. This allows building an explanation of the phenomenon including a reflection on rival theories. Different theories relating to the findings will be discussed in Chapter 7 (page 270).

The last test of internal validity is the use of logic models. The process and techniques used to build the logic models are described and presented in section 4.7 (page 150). The use of logic models incorporates matching empirically observed events to theoretically predicted events (Yin, 2003, p. 127). This has been established by defining and presenting the research framework (contextual framework, page 110) of pre-existing constructs and matching it throughout the process with empirically observed constructs.

Through the use of multiple sources, explanation building and matching theoretical constructs with empirically observed constructs; a sound internal validity has been established.

### 4.8.3 *External validity*

External validity deals with the concern of generalisability beyond the case study (Yin, 2003, p. 37). Yin (2003, pp. 33-37) stated that use of theory in single case research permits generalisability to a certain extent. The research design is a theory-elaboration design based on pre-existing theory. Generalisability can be assumed through similar findings from other studies. Furthermore, the pattern investigation has the advantage that patterns are used to capture, communicate and re-use solutions to a context-specific problem (DeLano, 1998; Rising, 1998a).

> "Each pattern describes a problem that occurs over and over again in our environment and then describes the core of the solutions to that problem

> in such a way that you can use this solution a million times over without ever doing it the same way twice." (Alexander, et al., 1977, p. x)

Generalisability is given to the extent that the context is appropriate or similar to the context identified. This means that the external validity of the results from this single case study research is not given in different contexts (for example different culture, organisational size or structure). Nevertheless, the research findings should not be seen as a universal law, but rather as guidance for 'actionable knowledge' and can inform practitioners and can refocus future investigation within the research domain.

### 4.8.4 *Reliability*

The second concern of the research process is the replicability and reliability of the study and consistency or stability of the investigative process (Denzin & Lincoln, 2000; Yin, 2003, pp. 37-39).

Gilbert (2008) stated that data is reliable when repeated measurements of the same item are consistent. The reliability of the quantitative analysis has been accomplished through Cronbach's alpha analysis and the analysis of significance. Some of the factors being measured have poor reliability (see in section 5.2, Table 5-3 on page 174). The reliability of the qualitative analysis (pattern codes) has been established through a systematic analysis of the focus groups and interview data, in which different opinions are contrasted and repeated items, are identified.

Replicability in case research can be established through the use of multiple sources and a protocol of the research process (step-wise process). Multiple sources have been used and a clear process of the research conducted was presented, which allows replicability. Furthermore, recordkeeping has been used to link events to date and source. However, the observed and recorded events are open to reconstruction and interpretation. Therefore, pattern codes and data were given to an experienced researcher in the field of dental medicine, which resulted in similar interpretations as recommended by Fox-Wolfgramm (1997). Additionally, replicability of exact findings may not be applicable as a researcher in a social process will not be a consistent instrument of data collection within every situation, which leads to the limitation of this research.

### 4.8.5 *Limitations*

Every study has limitations, therefore it is important to identify them and restrict the discussion related to the research question under investigation.

The limitations of the study include the limited categories and related factors as illustrated in the research framework (page 125). There are numerous factors influencing the creative and innovation performance within an organisation such as individual creativity (Runco, 2007; Weisberg, 2006), organisational influence (Amabile, 1996a, 1998; Amabile & Mueller, 2008), the complexity of multiple levels (Woodman, et al., 1993) and different systems (Iba, 2010). The entire complexity of every influential factor is very difficult to capture and overambitious task for a Ph.D. project. Therefore, the study is limited to the categories identified in the research framework at multiple levels. The study captured some of the complexity of a self-producing system through identifying patterns that described the coupling of different systems and self-production process. Further factors might influence the production of the spaces of creativity and innovation.

The measurement of creativity and innovation within organisations is a complex topic (Shalley & Zhou, 2008). An approach of self-perception of each employee was chosen as adopted by many scholars (Shalley & Zhou, 2008). The measurement of the quantitative survey focused on the performance of innovation (both major change and incremental change or improvement).

A further limitation of the study was that the entire complexity of all functions and departments of the organisation could not be investigated due to practical reasons and access to data subjects. Therefore, the study represented the organisation to a certain extent. Further research can investigate the identified influence factors and patterns in a large sample size and/or in multiple cases to investigate the phenomenon further.

The study was conducted in German and there might be some meaning lost in translation. Therefore a main concept identified in this study was kept in German, the '*Freiraum*' concept. The data collection in German may have limited reporting of the rich context collected.

### 4.8.6 *Conclusion to validity, reliability and limitations*

The discussion on the validity, reliability and limitations indicated that the findings are valid and reliable at the empirical, analytical and theoretical level. Each separate measured construct was reflected using recommended methods and are reliable to the extent as indicated in this thesis. Replicability is given through a clear outline of the research process of methodological design, data collection and analysis.

## 4.9 Conclusion

This chapter has examined the methodological approach taken in this research. This methodological approach included a philosophical stance on pragmatism, which is conducive to the multiple methods design of both 'hard' and 'soft' system investigation. This allowed the elaboration of a new perspective of creativity and innovation in organisation, namely, a self-reproducing perspective. The single case approach permitted the examination of rich contextual data at both the macro level (larger organisational context) and micro level (local context) and their recursive interaction. The research framework guided the data collection and analysis process, which allowed the interlinkage of the different data sets and the 'hard' and 'soft' system model. This methodological approach allows the research question to be answered within its limitations. The findings and system models of the multiple levels are discussed and presented in the next chapters.

# Chapter 5 Findings: Organisational context and organisational innovation capabilities

*"" If you're not failing every now and again, it's a sign you're not doing anything very innovative."*

*Woody Allen* cited in Dixon (2005, p. 146)

***Keywords***

Innovation performance · Improvement performance · Organisational context (structure of 'the organisation') · 'Hard' system model · Organisational innovation capability · Organisational improvement capability

## 5.1 Introduction

This chapter discusses the 'hard' system model of the organisational context in relation to innovation. This includes the examination and analysis of the qualitative survey data. The chapter is organised in four main parts.

1. The first part discusses the findings of the Confirmatory Factor Analysis (CFA). The CFA produced sixteen factors of the organisational context and two factors that represent the performance of (1) innovation (major change) and (2) improvement (problem solving and incremental change).

2. The factors of the organisational context and the factors of (1) innovation performance and (2) improvement performance are correlated with each other through a Pearson's Correlation Analysis (PCA) to identify their relationship. The analysis of the relationships revealed, if the relationship is positively or negatively correlated and how strong the linear dependency is between the factors. This identified the influence of the factors of the organisational context on the (1) innovation performance and (2) improvement performance.

3. The third part discusses factors, which are grouped together into 'groups of factors' through a CFA. These groups resulted in: (group 1) organisational culture (social space); (group 2) information and knowledge management (mental space); (group 3) organisational design (physical and regulatory space). A PCA allowed examining the relationships between the 'groups of factors' as well as with the performance factors of (1) innovation and (2) improvement. These identified relationships allowed modelling the 'hard' system model of the organisational innovation capability on both levels, (A) 'groups of factors' and (B) factors.

4. The last part of this chapter presents and discusses the 'hard' systems models of the organisational innovation capabilities and their implications.

## 5.2 Organisational context and organisational performance factors

This section discusses and presents, firstly, the performance factors of (1) innovation and (2) improvement. Secondly, the factors of organisational context are presented and discussed. These factors are constituted by several variables, which are presented and discussed in this section.

### 5.2.1 *Perceived innovation performance as viewed by the data subjects*

The investigation of the organisational context in relation to innovation requires examining the organisational innovation performance. The innovation performance is examined amongst the population of the survey study, who rated the innovation performance of their department and project team according to their personal perception and experience. These variables were used to examine the innovation factors through a CFA as presented in Table 5-1.

| Performance factors | Factor loading | Comm-unalities | Eigen-value | Cronbach's α | KMO |
|---|---|---|---|---|---|
| **(1)Innovation performance** | **3.137** | **2.279** | **2.854** | **0.799** | **0.840** |
| (K.7) Innovations are created by our team | 0.836 | 0.615 | | | |
| (K.6) The members of our team create process innovations | 0.748 | 0.518 | | | |
| (K.3) Our team continuously improves our business operations | 0.536 | 0.480 | | | |
| (K.2) Our team recognises constantly new business opportunities | 0.518 | 0.373 | | | |
| (K.12) Our department is known as one of the most innovative | 0.499 | 0.294 | | | |
| **(2) Improvement performance** | **1.965** | **1.359** | **2.467** | **0.684** | **0.840** |
| (K.1) We recognise potential improvements in our work | 0.783 | 0.588 | | | |
| (K.4) Our team resolves problems continuously | 0.600 | 0.366 | | | |
| (K.9) We continuously improve our products / services / processes | 0.582 | 0.406 | | | |

**Table 5-1: Confirmatory Factor Analysis: Innovation and improvement performance factors**

The resulting factors of the CFA are the organisational (1) innovation performance (major change) and (2) improvement performance (incremental change). The model of these two factors has a ‘good fit’ (goodness-of-fit: df: 13, ChiSquare: 19.312, p-value: 0.114).

The (1) innovation performance incorporates the variables of creating innovation (K.7, K.6), improvement of business operations (K.3), recognition of new opportunities (K.2) and overall innovativeness (K.12). One innovation measurement was deleted from the CFA through to the lack of common variance. This was the (K.5) creation of product or service innovation. A possible explanation for this is that the development of the automobile or truck takes up to six to eight years, which makes it difficult to clearly identify the responsibility for the innovation.

The (2) improvement performance (incremental change) factor incorporates the variables of recognition of improvements (K.1), the resolving of problems (K.3) and the continuous improvement of products, services or processes (K.9). This factor has the focus on problem solving and continuous improvement.

Each of these factors incorporates a linear scale with item values from -3 to 3. The items with a negative value identify that the data subjects experience a non-innovative environment, while the items with a positive value indicate an innovative environment. These two innovation performance factors provide the basis for the measurement of the organisational context in relation to firstly, the innovation performance and secondly, the improvement performance. The next step to build the ‘hard’ system model is the examination of the factors of organisational context.

### 5.2.2 *Factors of organisational context*

The organisational context was measured in nine different ‘intellectual bins’ (sections within the survey questionnaire) each incorporated six to thirteen statements to rate (variables). The nine different ‘intellectual bins’ are presented in Table 5-2. For a detailed discussion of the literature about the different organisational categories (‘intellectual bins’) see section 2.6 (page 58). For each section a CFA was executed according to the data analysis process as discussed in section 4.7.1 (page 150).

| Section | 'Intellectual bins' (survey sections) |
|---|---|
| B | Information and explicit knowledge |
| C | Implicit knowledge |
| D | Vision and leadership style |
| E | Organisational behaviour and climate |
| F | Organisational structure and workplace |
| G | Resources |
| H | Infrastructure and communication |
| I | Knowledge creation routines |
| J | Creativity routines |

**Table 5-2: List of 'intellectual bins' (section of survey study)**

The nine CFAs (per 'intellectual bin') resulted in sixteen factors of organisational context as presented in Table 5-3.

| | Factors of organisational context | Factor loading | Comm-unalities | Eigen-value | Cronbach's α | KMO |
|---|---|---|---|---|---|---|
| B | B.I Innovation information | 1.799 | 1.143 | 1.245 | 0.621 | 0.664 |
| | B.II Business support information | 1.230 | 0.752 | 0.992 | 0.505 | 0.664 |
| C | C.I Implicit knowledge management | 2.027 | 1.424 | 1.424 | 0.710 | 0.639 |
| D | D.I Leadership style | 4.090 | 2.817 | 2.660 | 0.802 | 0.771 |
| | D.II Vision communication | 1.450 | 1.378 | 1.511 | 0.668 | 0.771 |
| E | E.I Organisational behaviour I (openness, motivation & values) | 2.869 | 1.929 | 2.332 | 0.738 | 0.835 |
| | E.II Organisational behaviour II (mistakes & problem behaviour) | 1.889 | 1.190 | 2.121 | 0.634 | 0.835 |
| F | F.I Workplace | 1.965 | 1.506 | 1.904 | 0.687 | 0.756 |
| | F.II Organisational & team structure | 2.322 | 1.241 | 1.640 | 0.591 | 0.756 |
| G | G.I Financial & information resource | 1.771 | 1.176 | 1.247 | 0.623 | 0.648 |
| | G.II Knowledge & time resource | 1.300 | 1.025 | 1.161 | 0.548 | 0.648 |
| H | H.I Information infrastructure | 2.087 | 1.453 | 1.453 | 0.736 | 0.687 |
| I | I.I Knowledge creation processes | 1.634 | 0.908 | 1.556 | 0.774 | 0.559 |
| | I.II Knowledge creation - information systems | 1.352 | 1.376 | 1.215 | 0.610 | 0.559 |
| | I.III Knowledge creation - face-to-face discussions | 1.821 | 1.214 | 1.252 | 0.581 | 0.559 |
| J | J.I Creative methods and interdisciplinary working | 2.631 | 1.736 | 1.736 | 0.753 | 0.752 |

**Table 5-3: Confirmatory Factor Analysis: Factors of organisational context**

The several factors are constituted by several variables. Each variable is correlated (Pearson's correlation) with the factor they constitute, which represents the relationship between the variable and the factor. This is the factor loading, which is shown after each variable in brackets.

The first factors are related to information and explicit knowledge. The (B.I) *Innovation information* factor includes customer information (factor loading: 0.675), information about technology innovations (0.635) and product information (0.489). The second information factor, (B.II) B*usiness support information*, is constituted by information to support decisions (0.621) and information for business insights (0.609). Information and explicit knowledge is one side of the organisational information and knowledge resources. The other is implicit knowledge. The factor of (C.I) *Implicit knowledge management* incorporates the variables knowledge improvement through hiring experts (0.838), knowledge and skills training (0.677) and monitoring expertise (0.512). In addition to information and knowledge resources (intellectual space), the leadership and behaviour (social space) are an essential part of 'the organisation'.

The (D.I) *Leadership style* factor is constituted by the practices of challenging employees to create ideas (0.763), empowerment (0.721), open to new or unusual opportunities (0.632), practice of shared values (0.563), balancing operative and thinking time (0.555), listen to advice (0.52) and providing a shared goal (0.336). The leadership is closely linked to the vision and vision communication. The variables of vision communicated (1.024) and shared goal (0.426) constitute the factor of (D.II) *Vision communication.* Communicating the vision provides a shared goal throughout an organisation. Additionally, shared behaviour and practices produce the social context of an organisation. The first factor that represents the shared behaviour and practices is the factor: (E.I) *Organisational behaviour I.* This factor is constituted by the variables of share values (0.676), intrinsic motivation (0.632), positive atmosphere (0.545), open communication (0.513) and openness to change (0.512). A further factor representing the shared behaviour is the (E.II) *Organisational behaviour II*, which embraces the variables of no punishment of mistakes (0.782), valuation of new ideas (0.566) and freedom to speech (0.541). In addition to shared practices, the structure and workplace (physical and regulatory space) are part of 'the organisation' as an entity.

The (F.I) *Workplace* factor represents workplaces in which employees can work creatively (0.896), concentrate (0.733) and have a thinking space (0.336). The workplace in combination with organisational and team structure can permit or prevent the specific interactions between individuals (spaces) to emerge. The factor of (F.II) *Organisational and team structure* embraces the variables of interdisciplinary teams (0.52), structure allows approaching decision makers (0.517), structure permits diverse team learning (0.492), structure facilitates networking (0.398) and structure provides social space to exchange thoughts (0.395).

The regulatory space within an organisation includes available resources. The (G.I) *Financial and information resources* factor includes the variables: financial reasons prevent the implementation of novelty (0.725), availability of financial resources (0.585) and information availability to create business knowledge (0.461). In addition, the variables experts and knowledge resources (0.896) and available time to develop ideas (0.404) constitute the second resource factor: (G.II) *Knowledge and time resources*. A further 'intellectual bin' in which a CFA was executed is 'communication and infrastructure'.

In this CFA several variables within the 'intellectual bin' were deleted from the analysis through to the lack of common variance. This resulted in, firstly, only one factor of (H.I) *Information infrastructure*. This factor incorporates variables such as information technology system (IS/IT) that facilitate networking (0.714), IS/IT to share information (0.703) and IS/IT to store information (0.670). Secondly, there is no factor that represents a cultivated and shared communication type. This might be that communication within the organisation is diverse. Sharing of information and knowledge within an organisational setting incorporates standardised processes and cultivated spaces of knowledge creation (virtual, social and/or physical).

The 'intellectual bin' of knowledge creation routines and processes resulted in three factors: (I.I) *Knowledge creation processes*, (I.II) *Knowledge creation – information systems* (mainly virtual) and (I.III) *Knowledge creation – face-to-face conversations* (mainly social). The first factor of (I.I) *Knowledge creation processes* is constituted by defined processes to create context related knowledge (0.982) and workflows to communicate expert knowledge (0.652). The variables know-how creation through the use of IS/IT (0.902) and knowledge creation through IS/IT (0.450) produced the

(I.II) *Knowledge creation – information system* factor. The (I.III) *Knowledge creation – face-to-face conversations* factor is produced by the know-how creation in conversations (0.763), knowledge creation in face-to-face discussion (0.583) and knowledge exchange in conversations (0.475). Additionally to knowledge creation, several creativity routines and practices have been linked to organisational innovation.

The routines related to creativity that resulted in a factor are scenario creation to think about effects of ideas (0.685), combination of interdisciplinary expertise (0.684), specific method for idea creation (0.662) and viewing a problem from different perspective (0.6). As the focus of this factor is on creative methods and diversity the factor is named (J.I) *Creative methods and interdisciplinary working.*

These several factors represent different aspects of the organisational context and represent the structure of 'the organisation' as an entity.

### 5.2.3 *Conclusion to organisational context and organisational performance factors*

The CFA for each section produced, firstly, two performance factors of (1) innovation performance and (2) improvement performance. These two factors represented the collective capability of producing change that is of value to the company. Secondly, sixteen factors that represent the organisational context were produced by CFAs. The next building block of the 'hard' system model is the relationships between the factors of organisational context and the organisational performance of (1) innovation and (2) improvement.

## 5.3 Relationship of factors of organisational context and performance factors

This section discusses the relationship between the factors of organisational context and performance factors. The linear dependency between the factors is identified through a Person's correlation analysis (PCA). Firstly, the linear dependencies (relationship) between the (1) innovation performance and the factors of organisational context are investigated. Secondly, the relationships between the factors of organisational context and the (2) improvement performance are examined.

### 5.3.1 *Relationship between organisational context and innovation performance*

The relationship between the (1) innovation performance factor and the factors of the organisational context is represented by the Pearson's correlation coefficient ($r$). Each measured relationship has a significance value ($p$-value), which represents the probability that the relationship between the two factors occurred by chance. The relationships with a probability below 95% ($p$-value >= 0.05) are dismissed from the analysis. The relationships (linear dependencies) between the factors of the organisational context and the (1) innovation performance factor are presented in Table 5-4. The factors of the organisational context are presented in Table 5-4 in a hierarchical order dependent on the strength of the relationship with the (1) innovation performance factor. The Pearson's correlation coefficient is a standardised measure of an observed effect, which is categorised through the size of an effect where the value of ±0.1 represents a small effect size, ±0.3 a medium effect size and ±0.5 a large effect size (Field, 2005, p. 111).

| No. | Influence factors on innovation | r | *p*-value |
|---|---|---|---|
| 1. | Leadership style (D.I) | 0.489 | 0.000 |
| 2. | Organisational behaviour I (E.I) (openness, motivation & values) | 0.480 | 0.000 |
| 3. | Creative methods and interdisciplinary working (J.I) | 0.479 | 0.000 |
| 4. | Innovation information (B.I) | 0.410 | 0.000 |
| 5. | Organisational and team structure (F.II) | 0.376 | 0.000 |
| 6. | Knowledge creation – face-to-face conversations (I.III) | 0.364 | 0.000 |
| 7. | Knowledge creation processes (I.I) | 0.342 | 0.000 |
| 8. | Organisational behaviour II (E.II) (mistakes & problem behaviour) | 0.334 | 0.000 |
| 9. | Management of implicit knowledge (C.I) | 0.309 | 0.000 |
| 10. | Workplace (F.I) | 0.293 | 0.000 |
| 11. | Business support information (B.II) | 0.265 | 0.002 |
| 12. | Vision communication (D.II) | 0.227 | 0.007 |
| 13. | Information infrastructure (H.I) | 0.212 | 0.009 |
| 14. | Knowledge & time resources (G.II) | 0.210 | 0.011 |
| 15. | Knowledge creation – Information system (I.II) | 0.134 | 0.114 |
| 16. | Financial & information resources (G.I) | 0.103 | 0.217 |

**Table 5-4: Linear dependency (PCA) between factors of organisational context and the (1) innovation performance**

Table 5-4 shows, firstly, that the factor (I.II) and (G.I) are dismissed from the analysis, because of the high *p*-value. Secondly, all factors are positively correlated with the innovation factor, which shows that these factors are facilitating organisational innovation.

The three main factors, which are close to a strong effect size (±0.5) are (D.I) Leadership style, (E.I) Organisational behaviour I and (J.I) Creative methods and interdisciplinary working. This shows that organisational innovation is highly dependent on the leadership practices, shared behaviour and collective working.

(B.I) information relevant for innovation, (F.II) Organisational and team structure, (I.III) Knowledge creation – face-to-face discussions, (I.I) Knowledge creation processes, (E.II) Organisational behaviour II and (C.I) Management of implicit knowledge are also vital for the organisational innovation.

Factors such as (F.I) Creative work place, (B.II) Business support information, (D.II) Vision communication, (H.I) Information infrastructure and (G.II) Knowledge & time resources have an effect size between medium and small with the innovation performance. Nevertheless, show a positive relationship and influence the innovation performance.

These findings identified the relationships and their effect size of the relationships between the factors of organisational context and (1) innovation performance. The analysis identified that the most important factors towards an innovation performance are certain cultivated leadership styles, value, openness and intrinsic motivated driven behaviour and interdisciplinary working and use of creative methods. This indicates that innovation is strongly reliant on social influences. In addition, the relationships between the factors of organisational context and (2) improvement performance have been examined.

### 5.3.2 *Relationship between organisational context and improvement performance*

The relationships (linear dependencies) between the factors of organisational context and (2) improvement performance were investigated with the same analysis approach (PCA). The results of the PCA are presented in Table 5-5.

| No. | Influence factors on improvement | r | *p*-value |
|---|---|---|---|
| **1.** | Organisational behaviour I (E.I) (openness, motivation & values) | 0.510 | 0.000 |
| **2.** | Leadership style (D.I) | 0.501 | 0.000 |
| **3.** | Innovation information (B.I) | 0.471 | 0.000 |
| **4.** | Creative methods and interdisciplinary working (J.I) | 0.460 | 0.000 |
| **5.** | Organisational behaviour II (E.II) (mistakes & problem culture) | 0.431 | 0.000 |
| **6.** | Organisational and team structure (F.II) | 0.363 | 0.000 |
| **7.** | Business support information (B.II) | 0.330 | 0.000 |
| **8.** | Management of implicit knowledge (C.I) | 0.329 | 0.000 |
| **9.** | Knowledge creation – face-to-face conversations (I.II) | 0.327 | 0.000 |
| **10.** | Knowledge creation processes (I.I) | 0.324 | 0.000 |
| **11.** | Vision communication (D.II) | 0.298 | 0.000 |
| **12.** | Creative work place (F.I) | 0.275 | 0.001 |
| **13.** | Information infrastructure (H.I) | 0.199 | 0.014 |
| **14.** | Knowledge & time resources (G.II) | 0.199 | 0.017 |
| **15.** | Financial & information resources (G.I) | 0.189 | 0.023 |
| **16.** | Knowledge creation – Information system (I.II) | 0.136 | 0.108 |

**Table 5-5: Linear dependency (PCA) between factors of organisational context and (2) improvement performance**

Table 5-5 shows that (E.I) value, openness and motivation driven behaviour and certain (D.I) leadership practices are vital for an organisation to accomplish improvements. Furthermore, the importance of dealing positively with (E.II) mistakes and problems within daily interactions, (J.I) using creative methods and interdisciplinary working as well as information about products, customers and innovative technologies (B.I) are crucial for the continuous improvement and problem solving within Daimler AG.

Additionally, the factors of the organisational context all correlate positively with the (2) improvement performance and therefore, facilitating improvement. The factor, which was dismissed from the analysis due to the high significant value was the (I.II) Knowledge creation – Information system. The reasons for this might be that some require IS/IT in their job to accomplish improvement and some might not.

This investigation identified that the key factors of improvements are: (E.I) value, openness and motivation driven behaviour and certain (D.I) leadership practices, which related to social space of the organisation.

### 5.3.3 *Conclusion to relationship of organisational context and performance factors*

This section examined the relationships and their effect size of the factors of organisational context and performance factors of (1) innovation and (2) improvement. The findings revealed the importance of shared value, openness and motivation driven behaviour, certain leadership practices and the use of creative method and interdisciplinary working for innovation in organisations. Furthermore, information availability about customers, products and new technologies as well as a team and organisational structure that facilitate diversity, short degree of distance to decision makers and networking as well as knowledge creation in face-to-face discussions are vital for the innovation performance within an organisation. The findings have raised awareness that (1) innovation and (2) improvement are dependent on numerous different factors of organisational context. To identify which combined factors may have a greater importance for both (1) innovation and (2) improvement the factors are grouped together and their relationships with the performance factors are investigated.

## 5.4 'Groups of factors' of the organisational context and their relationship to the performance factors

The factors were combined through a CFA, which allowed building 'groups of factors'. These groups of factors were correlated with the performance factors through a PCA to identify their relationship with the performance of (1) innovation and (2) improvement. This section discusses the 'groups of factors' of the organisational context and their relationship with each other and with the (1) innovation performance and (2) improvement performance.

### 5.4.1 *Grouping of factors*

The resulting groups of factors, namely, organisational culture (OC), information and knowledge management (IKM) and organisational design (OD) are presented in Table 5-6.

| 'Groups of factors' of organisational context | Factor loading | Comm-unalities | Eigen-value | Cronbach's α | KMO |
|---|---|---|---|---|---|
| **Group 1: Organisational culture** | 2.434 | 2.099 | 3.650 | 0.861 | 0.842 |
| E.II Organisational behaviour II | 0.937 | 0.836 | | | |
| E.I Organisational behaviour I | 0.922 | 0.760 | | | |
| D.II Leadership style | 0.575 | 0.503 | | | |
| **Group 2: Information & knowledge management** | 2.262 | 1.837 | 2.843 | 0.723 | 0.842 |
| B.I Innovation information | 0.837 | 0.716 | | | |
| B.II Business support information | 0.708 | 0.434 | | | |
| C.I Implicit knowledge management | 0.363 | 0.336 | | | |
| I.I Knowledge creation processes | 0.354 | 0.351 | | | |
| **Group 3: Organisational design** | 2.378 | 2.153 | 3.148 | 0.749 | 0.842 |
| F.I Workplace | 0.794 | 0.538 | | | |
| F.II Organisational & team structure | 0.772 | 0.790 | | | |
| I.I Knowledge creation processes | 0.497 | 0.351 | | | |
| J.I Creative methods and inter-disciplinary working | 0.315 | 0.474 | | | |

**Table 5-6: Confirmatory Factor Analysis: 'Groups of factors' of organisational context**

The model of the factors has a good fit with its data (Goodness-of-fit: df:18, Chi-Square:22.107, p-value:0.227). Each of the 'groups of factors' is discussed in detail in the next three sub-sections.

### 5.4.2 *Organisational culture*

The first 'group of factors' is constituted by the two factors of organisational behaviour and the leadership style factor as presented in Figure 5-1. The Figure 5-1 shows the Pearson's correlation coefficient ($r$) between the different factors that constitute the group. This indicates that these three factors are closely dependent on each other.

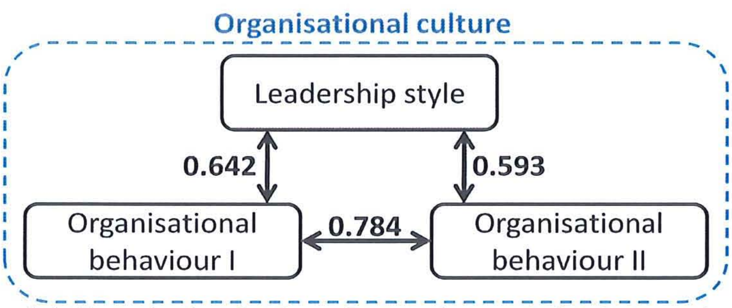



**Figure 5-1: Organisational culture (Pearson's correlation between factors)**

This 'group of factors', namely, *organisational culture* (OC) represent mainly the social aspect (social space) of 'the organisation'. For example, the social interactions of the leaders influence the behaviour of the employees and vice versa. These social factors build the large social space of the organisation, the cultivated social interactions. This social space influences the innovation performance.

The relationships between the OC and the performance factors of (1) innovation and (2) improvement are presented in Table 5-7.

| **Organisational culture** | **r** | ***p*-value** |
|---|---|---|
| Innovation performance | 0.456 | 0.000 |
| Improvement performance | 0.528 | 0.000 |

**Table 5-7: Pearson's correlation between 'organisational culture' and performance factors**

Table 5-7 indicates that OC influences the organisational (1) innovation with nearly a strong effect size and the (2) improvement performance with a strong effect size. The relationship between the organisational culture and the (1) innovation performance is illustrated in Figure 5-2.

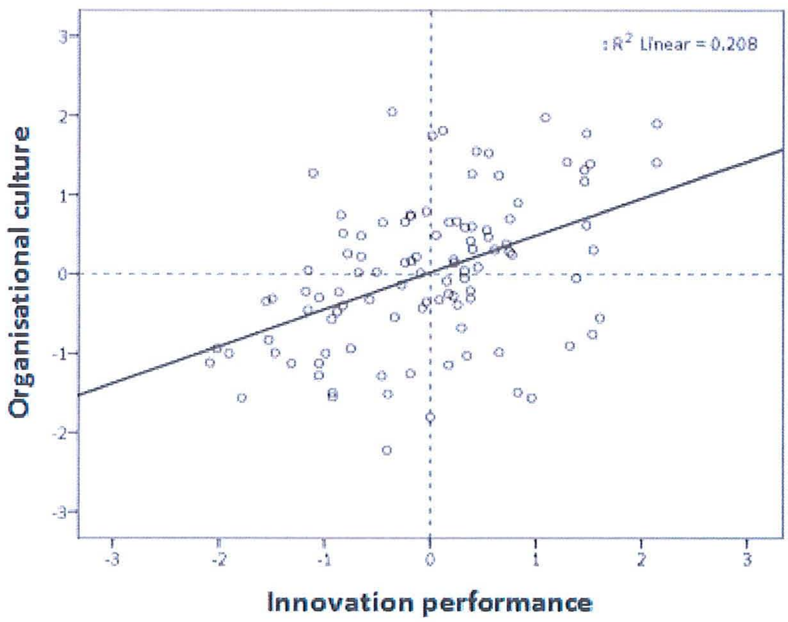



**Figure 5-2: Relationships between 'organisational culture' and 'innovation performance' (PCA)**

The figure shows that some data subjects have a 'positive' culture, but do not score very high in innovation performance (upper left quadrant). Furthermore, some data subjects have a 'negative' culture, but score relatively high on the innovation performance (lower right quadrant). Nevertheless, the majority shows a clear dependency between the ratio of OC and innovation performance (lower left and upper right quadrant). This indicates that organisational culture (OC) is a necessary factor in the innovation performance, but not sufficient to explain it.

### 5.4.3 *Information and knowledge management*

The second group incorporates the information factors, knowledge creation processes and management factors as presented in Figure 5-3. The close interdependency between the knowledge creation process, management of implicit knowledge and information relevant for innovation as well as the relationship with the information for decision-making is overall in the *information and knowledge management* (IKM) of an organisation.

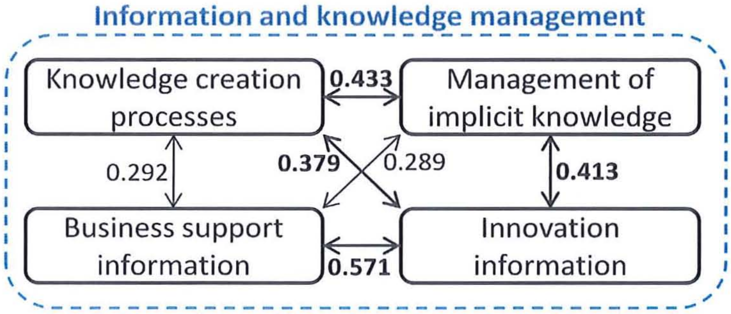



**Figure 5-3: Information and knowledge management (group of factors)**

This group is closely linked to the mechanisms that build expert clusters (mental spaces). For example, certain repeating knowledge processes and its management as well as the access to specific information can build shared context and shared understanding within different departments, groups or clusters. This allows building expert clusters as well as integration of these expert centres within the large organisational system. This influences the performance to accomplish both innovation and improvements.

The relationships between IKM and (1) innovation performance and (2) improvement performance are presented in Table 5-8.

| Information & knowledge management | r | *p*-value |
|---|---|---|
| Innovation performance | 0.430 | 0.000 |
| Improvement performance | 0.531 | 0.000 |

**Table 5-8: Pearson's correlation between 'information and knowledge management' and performance factors**

The table indicates that the IKM, firstly, has a nearly strong relationship with (1) innovation and, secondly, has a strong relationship with (2) improvement, similar to the relationship of OC. Obviously, IKM is a vital discipline in building an organisational innovation capability. The relationship between IKM and (1) innovation performance is illustrated in Figure 5-4.

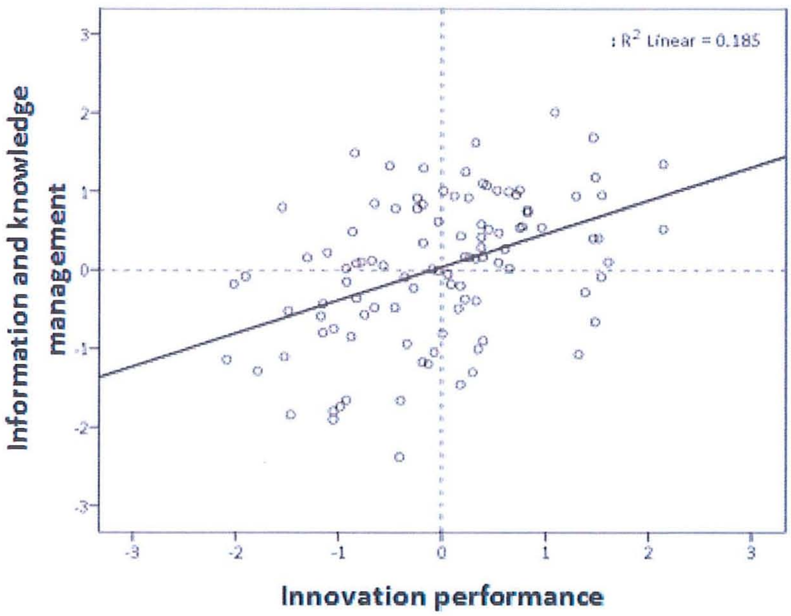



**Figure 5-4: Relationships between 'information and knowledge management' and 'innovation performance' (PCA)**

Similar to the relationship between OC and (1) innovation performance shows the relationship of IKM with (1) innovation performance that some data subjects are producing innovation with a 'negative' IKM (lower right quadrant) and some have a 'positive' IKM and do not score high on the innovation performance scale (upper left quadrant). However, the majority show clearly a dependency between IKM and innovation. Therefore, IKM is necessary, but not sufficient to build an organisational innovation capability.

### 5.4.4 *Organisational design*

The last group is the *organisational design* (OD), which incorporates the workspace, structure of teams and the organisation, processes of knowledge creation and creative methods and interdisciplinary working as presented in Figure 5-5.

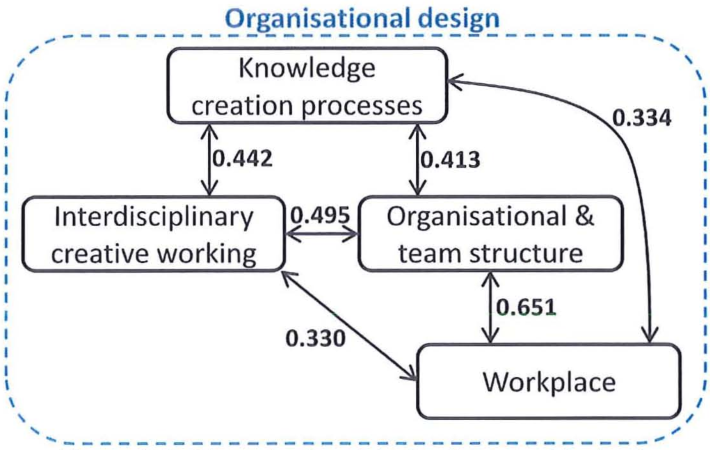



**Figure 5-5: Organisational design (group of factors)**

Workspace relates to the physical environment of the organisation, while structure, processes and working methods and routines relate to the regulatory space. Therefore, the OD mainly relates to the organisational system (physical and regulatory space). OD influences both the (1) innovation and (2) improvement performance.

The relationship between OD and (1) innovation and (2) improvement performance is displayed in Table 5-9.

| **Organisational design** | **r** | ***p*-value** |
|---|---|---|
| Innovation performance | 0.422 | 0.000 |
| Improvement performance | 0.459 | 0.000 |

**Table 5-9: Pearson's correlation between 'organisational design' and performance factors**

Table 5-9 shows that OD has a linear dependency with (1) innovation with an effect size between medium and strong, while the dependency with the performance of (2) improvement is closed to strong. The first relationship of the two is illustrated in Figure 5-6.

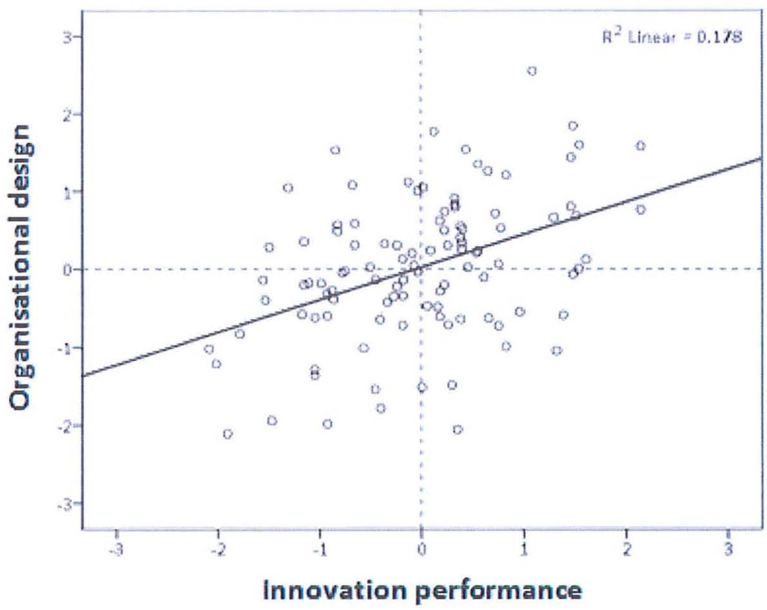



**Figure 5-6: Relationships between 'organisational design' and 'innovation performance' (PCA)**

The relationship between OD and (1) innovation shows about the same picture as the relationships of OC with (1) innovation and IKM with (1) innovation. Therefore, OD is also a necessity to build an organisational capacity, but in isolation not sufficient.

### 5.4.5 *Conclusion to 'group of factors' of the organisational context and their relationship to the performance factors*

Each 'groups of factors' represents a certain space. *Organisational culture* represents mainly the social space of the organisation, while the *information and knowledge management* represent mainly the mental space. The *organisational design* relates mainly to the physical and regulatory space. The 'groups of factors' are building the structure of 'the organisation' and cannot be considered in isolation. Therefore, innovation is not dependent on either the social, mental or organisational components, but rather an interrelating network of these components (organisational context), which produce the space of the organisational innovation capability.

## 5.5 'Hard' system models of the organisational innovation capability

The network of the (A) 'group of factors' and (B) factors build the organisational innovation capability as they positively correlate with the (1) innovation performance and (2) improvement performance. This section discusses the interrelations that build the 'hard' system model of the organisational (1) innovation capability and (2) improvement capability.

### 5.5.1 *'Hard' system model of the 'groups of factors'*

The different 'groups of factors', namely, organisational culture (OC), information and knowledge management (IKM) and organisational design (OD) are strongly interrelating groups. The relationships (PCA) of the 'groups of factors' and performance factors are presented in Table 5-10.

| | | IP | IMP | OC | IKM | OD |
|---|---|---|---|---|---|---|
| **Innovation performance (IP)** | r | 1 | | | | |
| | p-value | - | | | | |
| **Improvement performance (IMP)** | r | 0.659 | 1 | | | |
| | p-value | 0.000 | - | | | |
| **Organisational culture (OC)** | r | 0.458 | 0.528 | 1 | | |
| | p-value | 0.000 | 0.000 | - | | |
| **Information and knowledge management (IKM)** | r | 0.431 | 0.531 | 0.618 | 1 | |
| | p-value | 0.000 | 0.000 | 0.000 | - | |
| **Organisational design (OD)** | r | 0.422 | 0.459 | 0.713 | 0.587 | 1 |
| | p-value | 0.000 | 0.000 | 0.000 | 0.000 | - |

**Table 5-10: Pearson's correlation matrix ('groups of factors' and performance factors)**

As illustrated in Table 5-10 the OC and OD are very strong interrelated with an effect size of 0.713. OC and IKM have an effect size of 0.618 and IKM and OD have an effect size of 0.587, which are still very strong relationships. This shows that the OC, IKM and OD are strongly interrelating and dependent on each other. The relationship of the OC and OD is illustrated in Figure 5-7.

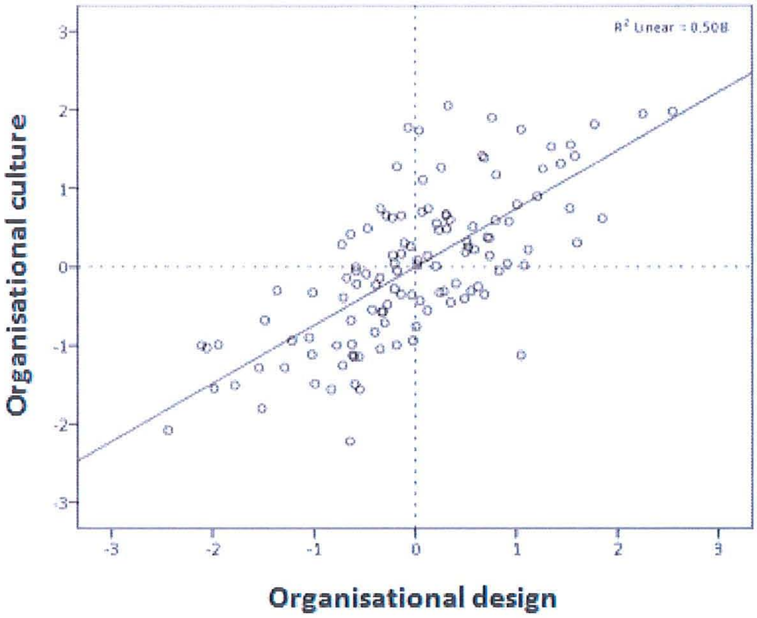



**Figure 5-7: Relationships between 'organisational culture' and 'organisational design' (PCA)**

Figure 5-7 indicates that the organisational culture (OC) is dependent upon the design of the organisation (OD) and vice versa. An example for this result might be that an OD with a flexible and open structure facilitates a more interactive behaviour or a motivated and empowered (self-determined) culture has the result of a less strict structure. Clearly, the OC and OD as well as IKM have strong impacts on each other.

Furthermore, these three 'groups of factors' have a strong or nearly strong positive relationship with the (1) innovation performance and (2) improvement performance as presented in Table 5-10. Therefore, the interrelating OC, IKM and OD build the (1) organisational innovation capability and (2) organisational improvement capability. The 'hard' system model of the 'groups of factors' of the (1) organisational innovation capability is presented in Figure 5-8.

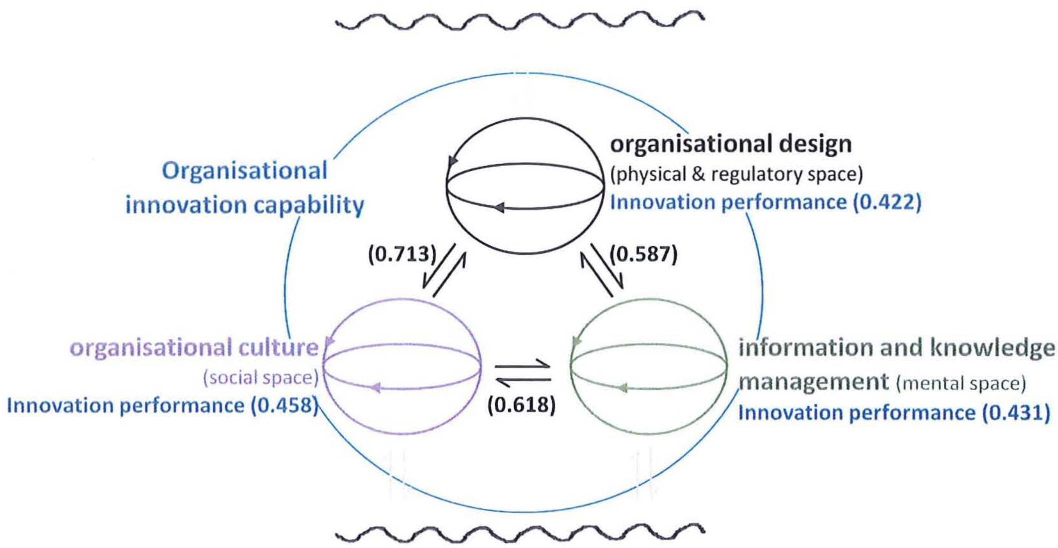



**Figure 5-8: Simplified 'Hard' system model of the organisational innovation capability ('groups of factors') – Pearson's correlation coefficient**

This simplified model of the organisational innovation capability shows the recursive interactions (arrows) between the organisational culture (social space), information and knowledge management (mental space) and organisational design (physical and regulatory space) and their effect size in brackets next to the arrows. Each of the groups of factors produces a space, which defines its own boundary and self-reproducing organisation. These spaces highly interact and can build a high organisational innovation capacity as the social (OC), mental (IKM) and physical and regulatory (OD) spaces can influence positively the innovation performance (effect size is illustrated in blue brackets). Therefore, when the inherent factors of the social space (OC), mental space (IKM) and physical and regulatory space (OD) interact in such a way that they build the structure (emergent from individuals' interactions), which is positively related to the innovation performance, 'the organisation' increases its innovation capability. The 'hard' system model in Figure 5-8 is a simplified model of the inherent complexity of the organisational innovation capability. The factors view of the innovation capability reveals a more detailed perspective.

### 5.5.2 *'Hard' system model of the factors*

The detailed perspective of the 'hard' system model of the organisational innovation capability is based on the interrelations of the factors of the organisational context and their relationship with the performance factors of (1) innovation and (2) improvement. The relationships are presented in the Pearson's correlations matrix in Appendix F (page 376). The 'hard' system models of

- Organisational innovation capability is presented in Figure 5-9 (page 192)
- Organisational improvement capability is presented in Figure 5-10 (page 193)

The 'hard' system models show the several factors of organisational context and their relationships. These relationships are presented as arrows. The effect size of the Pearson's correlation coefficient is illustrated by the width of the arrows. The positive relationship between each factor of the organisational context and (1) innovation performance and (2) improvement performance is illustrated by the saturation of the colour. The darker the presented factor the higher is the effect size of the positive relationship. The grey lines present factors (I.II and G.I in model 1 and I.II in model 2), which have no reliable relationship with the performance factor. These system models illustrate the complex structure of 'the organisation', Daimler AG, in relation to its innovation performance.

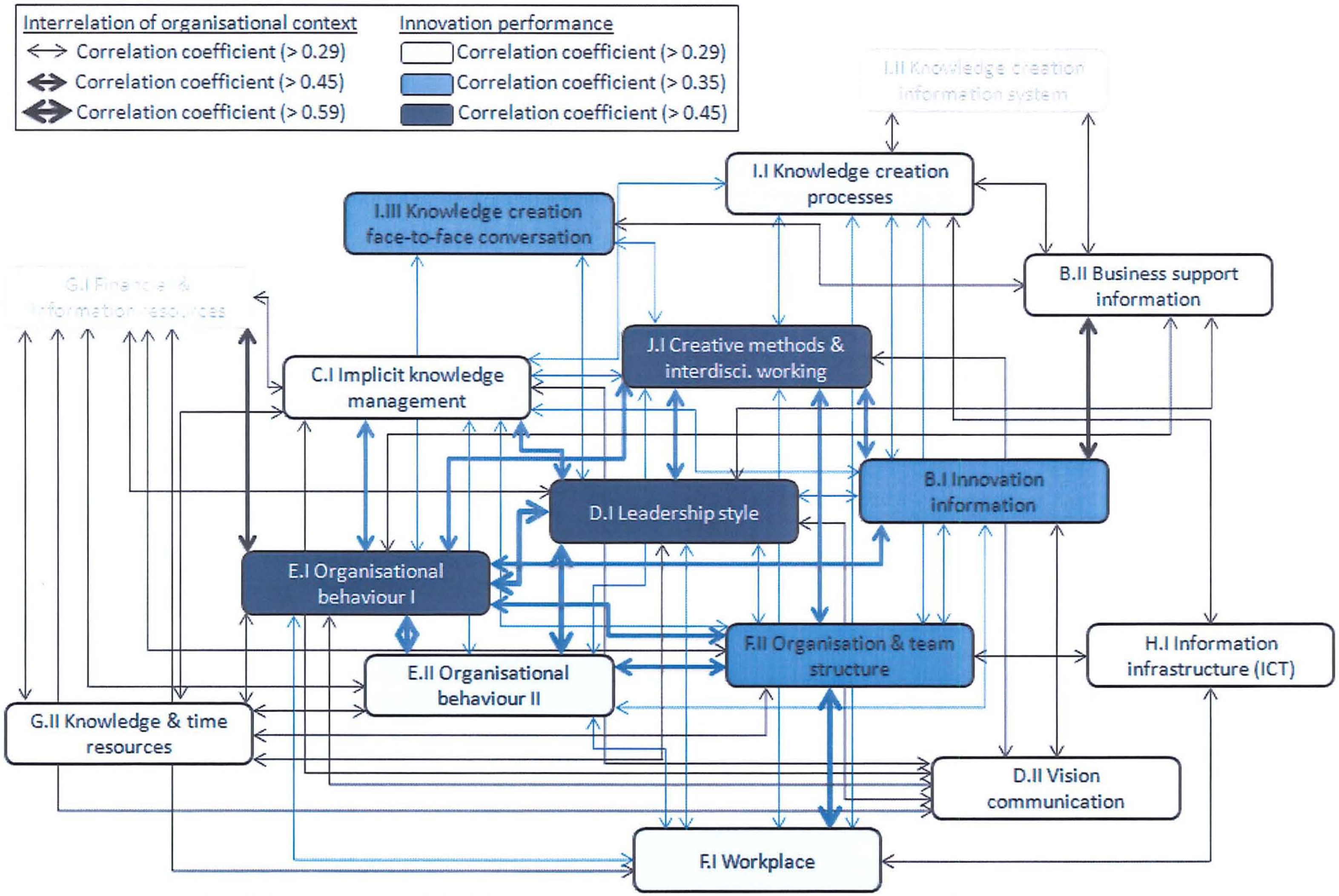



**Figure 5-9: 'Hard' system model of the organisational innovation capability (Pearson's correlation coefficient)**

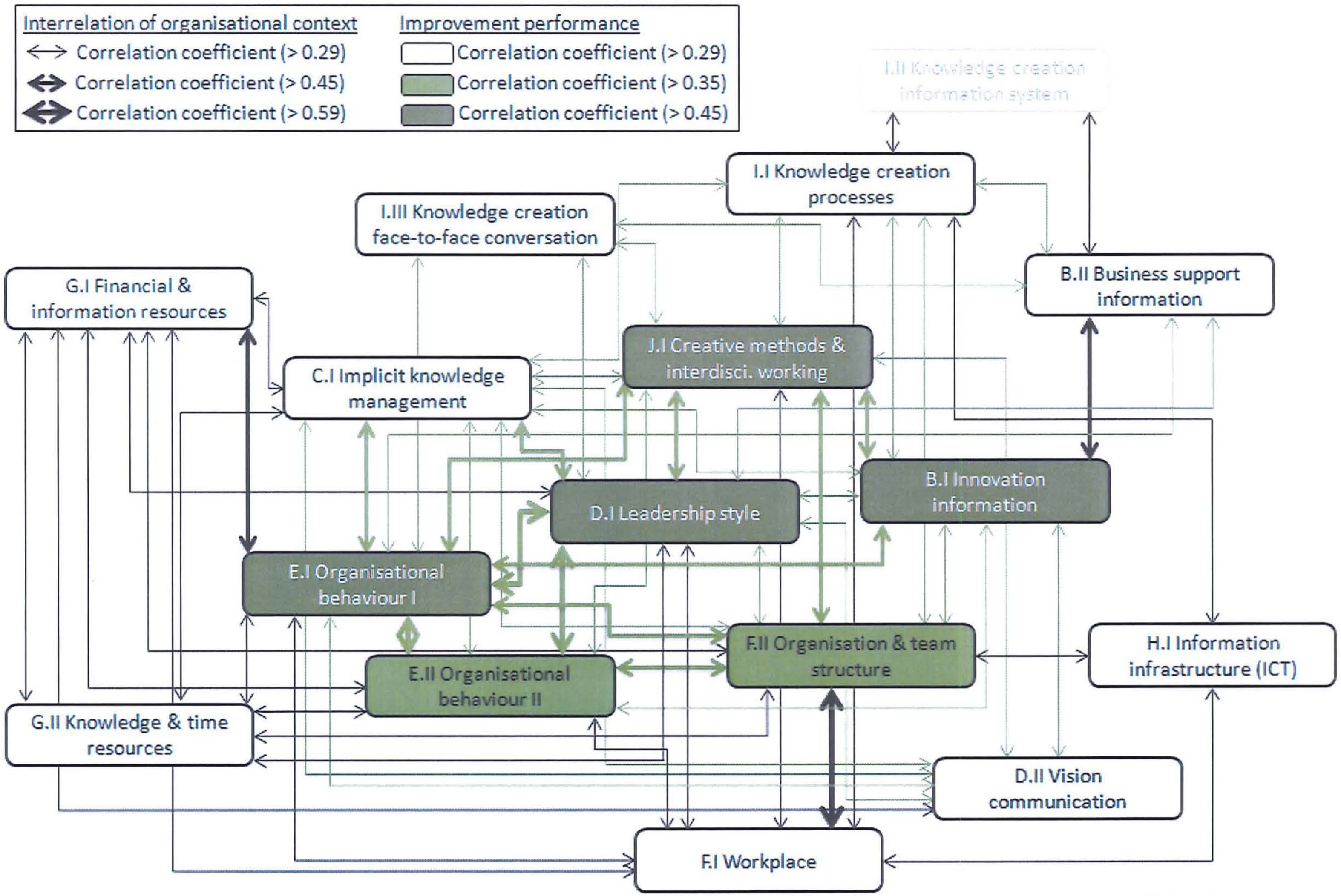



Figure 5-10: 'Hard' system model of the organisational improvement capability (Pearson's correlation coefficient)

The interrelations between the factors in the 'hard' systems models reveal that a change in one factor can result in change within several other factors. Therefore, change in one factor on an organisational scale can result in a so-called 'chain reaction' or system dynamic that can either dramatically increase or decrease the organisational capacity of (1) innovation and (2) improvement. An example of this 'chain reaction' (dynamics within the system) is, for example, reducing (G.I) financial resources influences (E.I) the value, openness and motivation driven behaviour, which is strongly interlinked with (E.II) mistakes and problem behaviour and (D.I) leadership practices. Therefore, financial resources influence directly and indirectly the social space within the organisation and ultimately the innovation capability.

This social space of shared behaviour and leadership influences further the (J.I) interdisciplinary working and use of creative methods, (C.I) implicit knowledge management and so forth. Therefore, an organisational wide change can result in change throughout the system. This shows that the regulatory space (for example budget) influences the social space (for example behaviour) as illustrated in the simplified system model of organisational innovation capability (Figure 5-8, page 190).

Another example is the (I.III) knowledge creation within face-to-face discussions. It is dependent on the (D.I) leadership practices, (E.I) value, openness and motivation driven behaviour (J.I) creative methods in use and the interdisciplinary working as well as the (B.II) decision support information available. Therefore, the organisation-wide knowledge creations within face-to-face conversations, which produce innovation within 'the organisation', are constituted by the behaviour of the employees, practices of leaders, interdisciplinary working and the business support information available. Each of these factors is dependent on several other factors, which makes the system highly complex and difficult to manage. Several other examples can be observed through identifying the several interrelations (arrows) of one factor with the complex network of the organisational innovation capability.

### 5.5.3 *Conclusion to 'hard' system models of the organisational innovation capability*

This section examined the interrelations between the several (A) 'groups of factors' and (B) factors. The interrelating 'groups of factors' built a simplified model of 'the organisation', which indicated that the organisational culture (social space), information and knowledge management (mental space) and organisational design (physical and regulatory space) are highly interrelating spaces, which produce jointly the organisational innovation capability. Due to the high interrelation a change in, for example, the regulatory space can result in a change in the social space and mental space. This change is not a direct cause and effect, but rather a change, which is produced by the influence and the self-reference (autopoietic organisation) as discussed in section 3.5 (page 89). Furthermore, a change in one space might improve the innovation capability, but consequently can reduce it in one of the other spaces and therefore reduces the organisational innovation capability, rather than increasing it. This requires the understanding of the complex system of the several (B) factors that influence the organisational innovation capability. This complex model indicates that the organisational innovation capability is difficult to manage because of its high complexity. The 'hard' system models unambiguously indicated that the organisational innovation capability is a highly complex system of many interrelating factors of the organisational context.

## 5.6 Conclusion

The findings of the quantitative survey revealed, firstly, that the main influencing factors of (1) innovation and (2) improvement at Daimler AG are the organisational behaviour and leadership practices, the social space (organisational culture). Similar to organisational culture, information and knowledge management (mental space) and organisational design (physical and regulatory space) are vital for the organisational innovation capability. Secondly, the findings indicated that the several factors of the organisational context are highly inter-dependent. Thirdly, the 'hard' model of 'the organisation' provides insights about the high complexity of the system structure of the organisational context, which facilitates the performance of (1) innovation and (2) improvement.

This ‘absolute view’ or ‘hard’ system model is only ‘one side of the coin’ as it represents a static view of ‘the organisation’. Creativity and innovation by its nature is a dynamic capability, which requires not standardisation (static system model), but rather room for emergence (dynamic system model). Therefore, it is required to investigate how the structure turns into process and process produces creativity and results in innovation. This links to the blind spot within mainstream management activities. The ‘absolute view’ of key performance indicators (KPIs) does not represent the dynamic and emergent capability of the organisation of knowledge, creativity and innovation. These structures (‘the organiation’) are produced by the actions and interactions of individuals (‘organising’), while the pre-existing structures constrained or enabled ‘the process’ (local context). Therefore, the processes (local context) that produce the structure (organisational context) need to be taken into account to identify the situations in which creativity can emerge and can produce innovation. The findings of the ‘process view’ of the local context within individuals’ interactions is examined and discussed in the next chapter.

# Chapter 6 Findings: Context of individuals' interactions and patterns of creativity

*"You have to create an oasis, a tortoise enclosure, where your 'tortoise mind' can come out to play. There are two things you have to do. You have to create boundaries of space and you have to create boundaries of time. [...] 'Boundaries of space' simply means you create boundaries to avoid the interruptions [...], which is so disastrous to the creative process. [...] Then you have to give yourself a starting time and a finish time, because when you do this you have created an oasis that is separate to ordinary life and then, and only then, can you play." John Cleese* ("John Cleese on creativity ", 2008)

***Keywords***

Local context within individuals' interactions · Patterns of creativity · 'Thick of the action' · Freiraum · A pattern language · 'Soft' system model ·

## 6.1 Introduction

This chapter discusses the findings of the pattern analysis of the focus group and interview data. This includes the presented variables of the organisational context of the survey study, which have been identified through a Pearson's correlation analysis (PCA) with the innovation performance factor. The pattern analysis resulted in nine different patterns, which are interrelating and produce dynamics of local context within individuals' interactions that facilitate creativity. The chapter is organised in ten parts.

The first nine sections of the chapter present the identified patterns. Each pattern consists of pattern elements. These pattern elements interrelate and build a pattern structure. This pattern structure reveals the dynamics that allow creativity to emerge for each specific 'intellectual bin'.

The last part is the pattern language. The nine different patterns interrelate to a web of patterns. This web of pattern reveals holistic dynamics or rules of creativity within individuals' interactions embedded in the large organisational context. The key dynamics identified in this chapter are (1) knowledge creation in the *thick in the action* ('im Geschehen sein'), (2) innovation willingness and change and (3) *Freiraum*. The first dynamic refers to the knowledge creation within the daily work routines and within the *thick of action* of a phenomenon at the place (*Ort*) of incidence or most potential. The second dynamic is the motivation, openness to change and risk-taking to create, actualise, develop and implement the change. The last dynamic is *Freiraum*. *Freiraum* is the German word for 'free space', 'free room' or 'free field'. Freiraum is considered not only a physical space, room or field, but rather as a space produced by social, mental and regulatory influences. The German dictionary 'Duden online' stated *Freiraum* as:

> "Opportunity to develop one's own strength and ideas (of a person or a group)" [in German: "Möglichkeit zur Entfaltung eigener Kräfte und Ideen (für eine Person oder Gruppe)"] ("Freiraum, der," 2012)

Examples for *Freiraum* are "to establish one's own *Freiraum* (free space)" or "to permit someone's *Freiraum* (free space)" ("Freiraum, der," 2012). This chapter discusses the several patterns, the dynamics inherent in the patterns, the pattern language and dynamics inherent in the language. The chapter ends with the 'soft' system model of local context, which allows creativity to emerge within interactions of individuals within the organisation, Daimler AG.

## 6.2 Pattern 1: Individual knowledge creation

The first pattern in relation to creativity is the pattern of individual knowledge creation. This pattern was examined by the pattern analysis as discussed in section 4.7.2 (page 158). The pattern incorporates the dynamic of information provision and availability and knowledge creation by individuals. This dynamic is constituted by several pattern elements.

### 6.2.1 *Pattern elements*

The first identified pattern elements of the individual knowledge creation are the (1.1) provision of information and (1.2) free availability of information as presented in Table 6-1. The pattern element of (1.1) information provision is composed of the variables B.3, B.5, B.4 and B.1 that represent the provision of different information.

| **Relationship to innovation performance** | | ***r*** | ***p*-value** |
|---|---|---|---|
| 1.1 | (B.3) Process information | 0.424 | < 0.001 |
| | (B.5) information about innovative technologies | 0. 325 | < 0.001 |
| | (B.4) Customer information | 0. 324 | < 0.001 |
| | (B.1) Product information | 0. 278 | < 0.001 |
| 1.2 | (B.12) Free availability of information | 0. 269 | < 0.001 |

**Table 6-1: Presented variables of 'intellectual bin' of information to focus groups (PCA)**

The variables (findings of survey analysis) in Table 6-1 were presented in the focus groups. The focus groups discussed these variables of the organisational context and their interrelations that produce the situations in which creativity emerges. The analysis of the focus group discussion and interview conversations revealed the pattern elements of this local context as presented in Table 6-2.

| Pattern element | | Key findings |
|---|---|---|
| 1.3 | Information internalisation | Information internalisation has been stated as recognising, learning, observing and seeing. Provided and available information are internalised by individuals to create task-relevant knowledge about product, process and customer and to create new ideas. |
| 1.4 | Information overload | Free available information can lead to information overload. This results in the loss of engagement in the essential task of individuals and therefore prevents the individuals from internalising and processing information (into a novel idea). |
| 1.5 | Engagement in essential task | For the internalisation and processing of information towards a creative idea, individuals need to engage in the essential task. The engagement in the essential task leads to the task-relevant knowledge creation.<br>Engagement in the essential task is vital for creativity and is influenced by the environment. Furthermore, collaborative engagement in the task can be difficult as different individuals have different interests/motivations/objectives. |
| 1.6 | Intrinsic motivation | Intrinsic motivation is a prerequisite to engage in the essential task and therefore to observe, explore and create ideas. Several interviewees stated that motivation or interest is a complex topic within an organisation as often the task responsible person might have a different interest (motivation) and interests can conflict with each other. This conflict often results through the 'management objectives' ('Zielvereinbarungen'). |
| 1.7 | Knowledge processing | The engagement in the essential task enables the creation and processing of knowledge into creative idea.<br>There were two different views stated in the interviews. On the one hand it was argued that idea creation requires a step-wise process, because we cannot count on creating ideas by change, while on the other hand it was stated that creativity can be based on a spontaneous mode, which can be triggered through conditioning the mind towards an 'idea pregnancy'. |

**Table 6-2: List of pattern elements of individual knowledge creation pattern (focus groups and interviews)**

These interrelating pattern elements of the local context build a pattern structure.

### 6.2.2 *Pattern structure*

The pattern structure illustrates the pattern elements and their relationships, which forms the pattern of individual knowledge creation as presented in Figure 6-1.

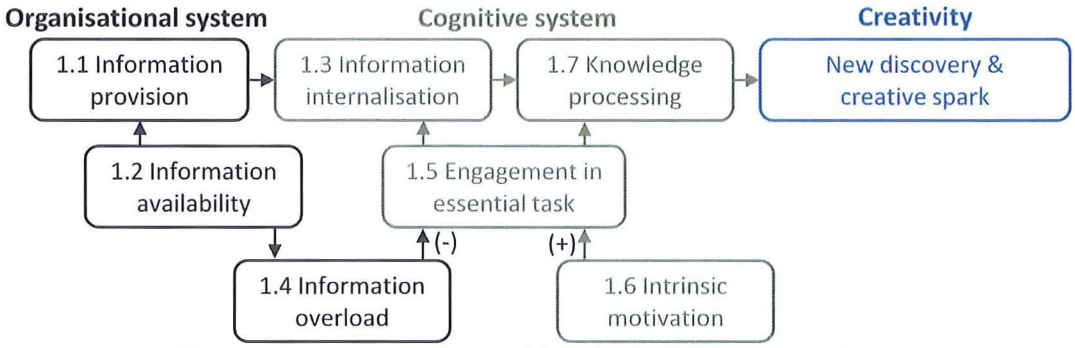



**Figure 6-1: Pattern structure of individual knowledge creation**

The pattern structure consists of seven different pattern elements of the organisational and cognitive system. This pattern illustrates the complexity of the creation of new sparks or discoveries of an individual.

The first identified relationship within the pattern is the interrelation between (1.1) information provision and (1.3) information internalisation. The focus groups stated the relationship between information, knowing and innovation as follows:

"It is certain that the **information needs to be internalised** to be able to innovate." (Senior Manager – Focus Group 2)

"The person, who does not have any **product information**, does not **know** how the product is developed. An employee, who has no **process information**, is not **able** to bring an innovation through the process, because he/she does not **know** where to begin. [...] The person who lacks **customer information** is not able to **develop** something that satisfies the customer." (Director of Engineering – Focus Group 1)

This indicates that the creation and development of novel and valuable ideas and solutions is dependent on the knowledge creation through information internalisation. The provision and internalisation of information is a necessary aspect of creativity within an organisation.

This (1.3) information internalisation as well as the (1.7) knowledge processing, which can lead to a new discovery, is influenced by the (1.5) engagement in the essential task of the individuals. This is the second relationship within the pattern as illustrated in Figure 6-1. The focus groups highlighted the importance of (1.5) engagement in the essential task to create a creative idea as following:

"Information has to do with the **ability to engage with the matter**, not only to provide a document." (Senior manager - Focus Group 2)

"It is just a question of **intensive engagement with the task** that it will process automatically in the back of one's mind. I had the best ideas when I was on the toilet."(Senior manager - Focus Group 2)

This implies that (1.5) engagement in the essential task is vital to generate task-relevant knowledge and to originate creative ideas. Similar findings provided the analysis of the interviews. Interviewees stated that employees require the room (space) in which they can focus on and engage in the task and work creatively. Furthermore, within daily work routines it is difficult to unify all the different task interests and objectives. The space in which employees can engage in the task allows unifying the different interests. The (1.5) engagement in the essential task enables the individuals to focus on the task and therefore to (1.3) internalise information and (1.7) process knowledge into a novel and valuable idea. Within an interview this task engagement was stated as the conditioning of the brain towards a 'problem pregnancy', which is essential to recognise something new in the environment or seeing something different. This task-engagement ('problem pregnancy') is influenced by the environment of the organisation.

Thirdly, the organisational environment can influence the (1.5) task engagement. For example, (1.2) information availability can lead to (1.4) information overload with the consequence that the (1.5) task-engagement is decreased. The focus groups stated that the (1.4) information overload can lead to the (1.5) disengagement of the essential task.

"[...] there is a problem of **providing too much information**, which leads to the **loss of focus to the essential task** and this is harmful [for innovation]." (Director of Engineering – Focus Group 1)

This implies that individuals, which have to deal with too much information on a daily basis have difficulties of (1.5) engaging in the task and therefore do not (1.3) internalise necessary information relevant to the task and are unable to (1.7) process them into novelty. The second focus group identified this dynamic within the organisation as the problem of too many formal meetings and too many emails (as examined in pattern 7 on page 232). Several interviewees pointed out similar to the information overload that the daily routine work and high workload can prevent the task engagement. In contrast, the task engagement can be increased by self-determination and intrinsic motivation.

(1.6) Intrinsic motivation drives the (1.5) engagement of individuals. The focus groups argued that (1.6) intrinsic motivation is the drive for knowledge creation.

Person A: "So, I do interpret and imply that the 'Bewohner' [Inhabitant - characterised as satisfied and not-motivated] could not care less about the information. In essence they come to work, do their job and leave again to go back home."

Person B: "The information provision and use is one criterion, but intrinsic motivation plays a key role. If we are not motivated, information is not processed into something novel."

Person C: "This is exactly what I am saying!" (Focus Group 2)

This suggests that individuals need to be (1.6) intrinsically motivated to (1.5) engage in the essential task to create new knowledge. Intrinsic motivation can be increased or decreased by the environment. Several interviewees have stated the motivation in relation to ideas creation and the environmental effects that increase or decrease motivation. Some key findings are presented in Table 6-3.

| **Motivation** |
|---|
| Motivation to create and develop new ideas and concepts is lost over time when nobody provides the resources for new ideas or concepts. If ideas are heard and supported this drives the motivation to create new ideas (positive enforcing cycle of idea creation) |
| Motivation is the driver in all processes. |
| The identification of mistakes and problems is based on motivation |
| If management engages with employees this drives motivation (appreciation is a drive of motivation). |
| The combination of challenge and motivation drives innovation. |
| Inno-Jams (open idea portals) facilitate the motivation to create and express new ideas (social reward through idea presentation and ownership). |
| Motivation of the creative employees ('Ideenträger') is the alpha and omega |
| Willingness to take risks is also a question of motivation (see pattern 4). |
| "We are going to make it happen" (implementation of ideas) is a driver for motivation to create and implement ideas. |
| The art of motivation is to bring the different interests and motives in line. |
| Fear of managers decreases the motivation. |

**Table 6-3: Key findings of intrinsic motivation within the organisation**

### 6.2.3 *Conclusion to pattern 1: Individual knowledge creation*

The pattern identified the dynamics of individual knowledge creation towards a creative discovery within the organisation. This creative discovery is determined by environmental factors such as amount of information and factors inherent in the individuals such as intrinsic motivation. The recursive interaction of the environment (organisational and social system) and the individual (cognitive system), which produce the momentary events (spaces) in which individuals can engage in the task through self-determination (intrinsic motivation) facilitates creative discoveries. The next pattern identifies the dynamics of momentary situations (local contexts) of creativity within conversations, dialogue and groups.

## 6.3 Pattern 2: Co-creation

The collective knowledge creation that leads to inspiration and creativity or co-creation is the second pattern. This pattern identifies certain mechanisms or dynamics (chain of momentary events) that facilitate inspiration and creativity within group conversations.

### 6.3.1 *Pattern elements*

The variables of the organisational context (macro level) that turns into local context within individuals' interactions are presented in Table 6-4.

| **Relationship to innovation performance** | | $r$ | $p$-value |
|---|---|---|---|
| 2.1 | (C.4) Training to create adequate expertise and skills | 0.314 | < 0.001 |
| | (C.5) Continuous improvement of the corporate knowledge base (e.g. hiring experts) | 0.272 | < 0.001 |
| 2.2 | (C.9) We know-who has the expertise in which department | 0.311 | < 0.001 |

**Table 6-4: Presented variables of 'intellectual bin' of implicit knowledge (PCA)**

These variables are the pattern elements within the local context that establish conversations, dialogues and groups. These pattern elements are (2.1) expert acquisition and development, which consists of the variables of training and improvement of corporate knowledge base by, for example, hiring experts and (2.2) 'knowing-who'. The identified pattern elements by the focus groups are presented in Table 6-5. This table shows that pattern elements that establishes the co-inspiration and co-creation within the organisation. This collaborative function of co-creation is vital for creativity and innovation. The themes such as collectively ('gemeinsam') and collaboratively ('zusammen' and 'miteinander') in relation to co-creativity and innovation has been stated three hundred twenty three time (323) within the interviews, which makes it one of the most stated themes by numbers.

| **Pattern element** | | **Key findings** |
|---|---|---|
| 2.2 | Knowing-who | Knowing-who is the expert enables one to create small groups and dialogue discussion that lead to the creation of appropriate new knowledge. Knowing different experts enables new knowledge creation (networked knowledge creation in the organisation). |
| 2.3 | Group composition | Knowing the talents, expertise, personal characters of individuals and the interplay and outcome of these individuals can establish a group in which creativity can emerge. Key finding in the interviews is that groups should be composed interdisciplinary with the different function relevant to the task. Furthermore, a 'variable of disturbance' (redundancy) can facilitate creativity such as someone with a conflicting or extreme perspective. |
| 2.4 | Group establishment | Groups are established (A) by regular communication in project teams; (B) through dynamic self-organisation; (C) occur at coffee corners. (B) and (C) are linked to creativity. |
| 2.5 | Dialogue | The dialogue is the type of conversation (and social interactions) in which experience and insights are shared and mutual inspiration and creativity can emerge. For the dialogue to occur specific social factors are required within individuals' interactions. |
| 2.6 | Sharing of experience and insights | The sharing of experience and insight stimulates the individuals in the conversation. This leads to mutual inspiration, advancement, solutions and creative ideas. |
| 2.7 | Blind date | A blind date (individuals do not know each other or know each other hardly) can enhance creativity, when individuals' connect socially. This composition can prevent 'groupthink'. |

**Table 6-5: List of pattern elements of co-creation pattern (focus groups and interviews)**

These pattern elements build a pattern, which represents the simplified complexity of co-creation within a social network and an organisation.

### 6.3.2 *Pattern structure*

The pattern structure of collective knowledge creation (co-creation) illustrates the flow of events that establishes informal discussion of dialogue. The pattern is presented in Figure 6-2.

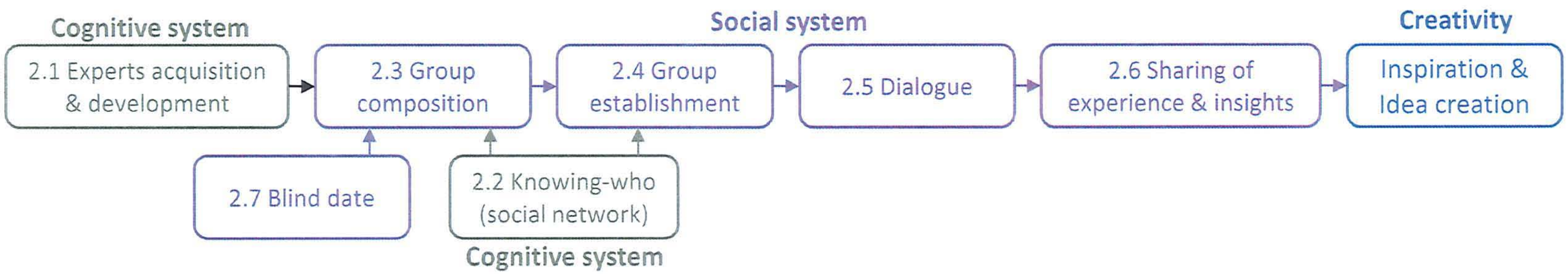



**Figure 6-2: Pattern structure of co-creation (collective knowledge creation)**

The first dynamic interrelation within the pattern is the combination of (2.1) expert acquisition and development, (2.2) 'knowing-who' and (2.3) group composition to (2.4) establish groups. This has been exemplified by one focus group as an analogy of two music bands, which have to play together.

"In the back of my head crystallises a picture, when I have to think about two music bands, which have to play together. This will only work, if you **know** the **existing talents** or **professional** musicians, the **interplay of the characters**, **roles**, **expertise** and the **resulting options**." (Director of Engineering - Focus Group 1)

The analogy of the music bands implies that experts (talents and professionals) need to exist or (2.1) hired and trained to provide appropriate expertise for the innovative task. Secondly, the employees need to (2.2) 'know-who' has the appropriate expertise and skills (talent, role and character) to provide support for the creative task. The 'knowing-who' enables an individual to bring the experts together within a large social network and a large organisation like Daimler AG. The focus groups highlighted this 'knowing the network of experts' is vital for creativity:

"An employee works on a topic and he/she **knows the network of the experts**, the individual is able to create new knowledge through establishing **small groups** or through **discussions and dialogue**. Therefore the individual has a greater chance to **create the appropriate new knowledge** then someone who has not the knowledge about where the expertise is spread." (Director of Engineering - Focus Group 1)

This builds the 'liquid network' in which ideas can spread within an organisation. The flow of momentary events that leads to the establishment of groups that can lead to creation of appropriate knowledge, inspiration and creativity is illustrated in Figure 6-3.

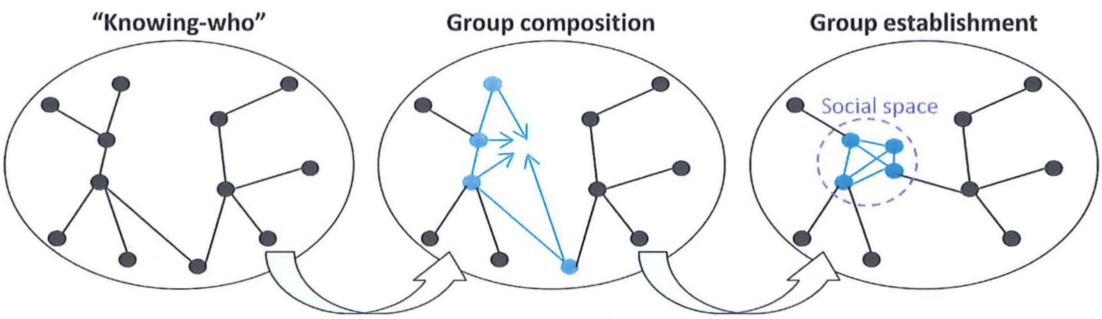



**Figure 6-3: The self-organisation of a social space within large social system**

This illustrates the self-organisation of the local social space within the larger organisational network through 'knowing-who'. This self-organisation through 'knowing-who' has two implications. On the one hand it allows the production of trustful social spaces and dialogue, which allows open communication and speaking out ideas without being afraid of punishment and/or 'stealing of ideas' as stated in the interviews. On the other hand these individuals might meet regularly, which can result in the self-reproduction of the same thoughts and ideas ('groupthink'). Therefore, the focus groups stated that,

"There is definitely the phenomenon, when **teams and team members do not know** each other, which then **connect relatively fast** and this is a very interesting phenomenon, because this **shapes the creative process** and **results in novelty**. This is very **innovative**! It might be a bit farfetched, but from this point of thought one is able to establish continuous improvements through bringing groups together, which initially do not know each other. Of course, the **most important thing is to bring them together.**" (Director of Engineering - Focus Group 1)

This implies that a so-called (2.7) blind date of individuals, which establishes a 'human connection', can facilitate creative dialogue. It also implies that two attributes shape the creative process in groups, namely, 'groupthink' and 'bonding of the individuals'.

The focus groups further emphasised that the self-organised (2.4) established informal discussions of (2.5) dialogue are conversations in which creative ideas emerge. This pattern was highlighted by the first group:

"In the **dialogue** one gets stimulated through the **exchange of insights and experience**, which **inspires mutually** and this leads to advancement. And this is not possible through email exchange or through databases. This is only possible, if you **take the time to exchange experience**." (Senior Manager - Focus Group 1)

This illustrates how self-produced social spaces can establish conditions in which creative ideas emerge. This dynamic of self-organisation of social spaces (dialogue) can establish mutual inspiration and generation of creative ideas. The analysis of the interview data revealed that too much workload, no time available, different interests and different and conflicting 'management objectives' ('Zielvereinbarungen') can prevent the production of the social space of dialogue and therefore mutual inspiration and creativity. Three different conversation types have been identified in the interview data, which result in different outcomes as presented in Table 6-6.

| Types of conversations | Modes explained by data subjects | Identified mechanisms |
|---|---|---|
| Conflict | Conflict can sometimes occur, because not everybody can fulfil their interests and ideas. These conflicts occur when integrating the several modules of the automobile. The 'goal conflicts' are escalated to the management, which make the decision. These decisions are also based on recommendation by the employees, which lead to a 'competition of convincing peers'. | Conflicting management objectives (initial trigger), individuals act on self-interest, opinionated leaders |
| Compromise | The compromise is the most common conversation type. These conversations are based on the understanding of other's views, but time pressure does not permit finding the ultimate or most innovative solution. (Visiting other work places ('*vor Ort*') helps to understand other's views). | Dialogue conversations, accepting others point of view, no openness to change, not enough time and resources available |
| Synergy (Creativity) | Synergies are the identification and solving of two different conflicting perspectives, which can lead to a novel and valuable concept. Example: 'Smart fortwo' car combines plastic and mental into a synergy | Dialogue conversation, accepting others point of view, openness to change, time and resource available for experimenting |

**Table 6-6: Types of conversations (interview analysis)**

The synergy conversation has been exemplified by an interviewee as a "joy-stick and steering wheel challenge". One group had the goal of inventing a 'joy-stick' for steering an automobile. The other group had the goal of a 'steering wheel'. Both groups were focused on winning the challenge that their entire focus was on achieving their goal. The creative process starts in that moment when the challenge was taken away and the groups started thinking, in such a way that they combined the two approaches and thinking 'besides the thought path of the specific goal (either joy-stick or steering-wheel).

### 6.3.3 *Conclusion to pattern 2: Co-creation*

This pattern of co-creation identified the context and dynamics of momentary events (social spaces) that can either allow or prevent creativity to emerge within individuals' interactions. The next identified pattern is the pattern of vision, strategy and leadership.

## 6.4 Pattern 3: Vision, strategy and leadership

The third pattern is the pattern of vision, strategy and leadership that facilitates the *Freiraum* (free space). The *Freiraum* is a 'time space' and 'free social space' within the regulatory space and social space. This *Freiraum* permits the creation of new concepts, ideas and approaches (strategic elements) within the boundaries of the organisational vision. The vision and ideas are combined and transformed into a strategic road map to fulfil the vision with innovative concepts. The pattern identifies the dynamics of vision, strategy and leadership practices that produce the *Freiraum* (free space).

### 6.4.1 *Pattern elements*

The variables identified in the quantitative survey analysis (PCA) that stimulated the focus groups discussions are presented in Table 6-7.

| **Relationship to innovation performance** | | ***r*** | ***p*-value** |
|---|---|---|---|
| 3.1 | (D.7) Challenge by leaders to create own ideas | 0.451 | $< 0.001$ |
| | (D.6) Empowerment by leaders | 0.406 | $< 0.001$ |
| 3.2 | (D.4) Shared vision | 0.345 | $< 0.001$ |
| 3.3 | (D.9) Practice of values by leaders | 0.304 | $< 0.001$ |

**Table 6-7: Presented variables of 'intellectual bin' of vision & leadership (PCA)**

These variables constitute the pattern elements of (3.1) challenge and empowerment by leaders, (3.2) shared vision and the (3.3) practice of shared values by leaders. The pattern elements that permit or prevent creativity to emerge within momentary events (local space) are (3.4) acceptance of challenge, (3.5) Freiraum, the (3.6) orientation phase and the (3.7) strategy phase as presented in Table 6-8.

| Pattern element | | Description |
|---|---|---|
| 3.1 | Challenge and empowerment | Empowerment produces a space in which employees can freely self-determine their actions (e.g. exploration of ideas), while challenge to create new ideas can drive them to engage in a self-determinant task and produce novelty.<br>Furthermore, empowerment is based on trust and therefore Freiraum is demolished when trust is lost. |
| 3.2 | Vision (open direction) | The vision provides the direction and challenge for producing novel ideas. The vision in comparison to strategic objectives provides wide and open boundaries in which 'strategic innovation' can emerge. This vision needs to be a usable direction, which is at the same time open for many possible ideas. For example: A vision such as the next Business car allows on the one hand a clear direction and on the other allows 'room' (space) for several ideas. Therefore, a vision needs to fulfil two attributes: (1) open and free space (Freiraum) for many different ideas and (2) clear direction. |
| 3.3 | Practice of shared values | Practices are embodied by leaders in daily action, interactions and momentary events such as appreciation. Appreciation has been stated the shared value relevant for creativity and innovation by interviewees. |
| 3.4 | Acceptance of challenge | The acceptance of challenge is based on the concept of innovation willingness. This includes willingness to create ideas and develop them into innovation (see pattern 4 on page 216). |
| 3.5 | Orientation phase | The 'orientation phase' provides a temporary Freiraum (regulatory free space) in which employees are empowered to contribute with ideas to the strategy. This phase allows building a strategic roadmap in which both, the strategic and operative perspectives are taken into account (top-down and bottom-up combined). A consequence of this stated by several interviewees is that it motivates employees to execute the strategy. |
| 3.6 | Strategy phase | Strategy phase without the orientation phase is a pure top-down process, which allows not much 'room' (space) for novel ideas. This shapes the creative performance of the individuals as they are limited in the production of novelty. |
| 3.7 | Freiraum | The concept of Freiraum in relation to vision, orientation phase, strategy phase and empowerment (leadership) is the establishment of a free space in which novel ideas can be produced (within the open boundaries of the vision) and can be combined with the strategic direction into a strategic route-map, which allows space for novelty and implementation of innovation. |

**Table 6-8: List of pattern elements of vision, strategy and leadership (focus groups and interviews)**

### 6.4.2 *Pattern structure*

The patterns structure provides insights of how the regulatory space and social space produce a space in which creativity can emerge. The pattern structure is illustrated in Figure 6-4.

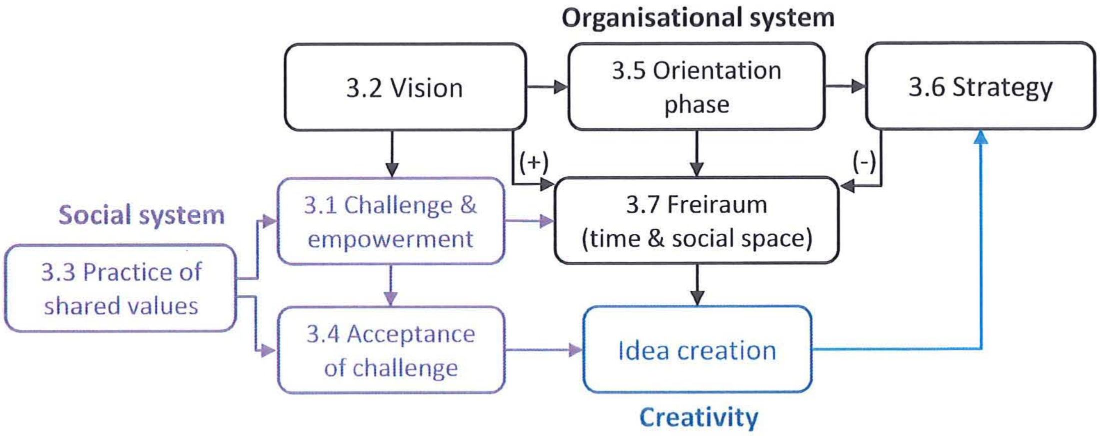



**Figure 6-4: Pattern structure of vision, strategy and leadership**

This pattern consists of two parts: (A) vision and leadership, (B) organisation and strategy phase.

(A) The vision and leadership includes the relationships between the (3.2) vision, (3.1) challenge and empowerment, (3.3) practice of shared values and the (3.4) acceptance of the challenge towards the creation of ideas. These relationships were summarised as following:

"For me it would be the subject of management and strategy. This is an essential point. This contains the **generation of a vision** and the **creation of ideas to fulfil the vision**. It also includes the **acceptance of these challenges** and to implement the ideas, so that the Daimler-**values** [passion, respect (appreciation), integrity and discipline] accentuate throughout their full potential." (Senior Manager - Focus Group 1)

This indicates that employees responsible for strategy need to be creative to develop a creative (3.2) vision and the employees on the operational level need to produce novel ideas to fulfil this (3.2) vision. This is the first step of the combination of the top-down and bottom-up process. The role of leadership in this dynamic is to transform the vision into a (3.1) challenge for employees and empower them. By (3.1) empowering employees and (3.3) practicing values such as appreciation they produce a (3.7) social space (*Freiraum*) in which employees can be creative. Employees need to (3.4) accept the challenge (motivation) to make use of the (3.7) social space of self-determinacy (*Freiraum*).

The process from (3.2) organisational vision to idea has been institutionalised at Daimler AG through a process involving the steps from (I) vision to (II) 'theme field' (space of a theme) to (III) 'search field' (space of exploration) towards new ideas. This process can be exemplified as the following: The vision of environmental friendly driving leads to the 'theme field' of, for example, light weight automobile, which can lead to the search field such as light seats. For the developing of light seats one could come up with a novel idea such as a 'harness' as seat. An innovation manager has stated this example.

The vision furthermore enables employees to contribute to the strategy with their ideas to fulfil the vision. This has been identified as the following:

"[...] I think that the **vision** is nicer than the **strategy**. If I have the corporate vision, I can **enable employees** to contribute. Therefore they can bring the strategic elements to fulfil the **vision**." (Director of Engineering – Focus Group 1)

The (3.2) vision opens up the space, in which employees can contribute to (3.6) strategy with novel ideas, which allows the combination of strategic direction and operative ideas into a strategic road map. This space cannot occur without an (3.5) orientation phase within the organisational system (regulatory space).

(B) The second dynamic of this pattern is the orientation and strategy phase. The focus groups reflected the orientation phase and strategy phase as the following:

Person A: "What I prefer much more than the **strategy** is the '**phase of orientation'**, namely because there is less obstruction produced than in the strategy phase.

Person B: "So I think it fits together as we say that **innovation** is more likely within the '**boundaries of guidance**', the **vision**, while the **strategy** is already the '**marching direction**', of how do I implement it. So if I want to innovate, the **vision** is actually the better orientation."

Person A: "The more **autonomous** [orientation]."

Person C: "But then the task must be also **free [autonomous]**."

Person B: "Exactly! **Innovation** is created under the condition of **autonomy** and therefore easier created as under the condition of a 'regiment' [strict conditions as in military units]." (Focus Group 1)

This implies that the (3.2) vision can provide at the same time open boundaries (an open mental space, *Freiraum*) in which new ideas can be created and strategic direction. Furthermore, a (3.5) phase of orientation allows a (3.7) free time space (*Freiraum*) in which ideas (related to the vision) can be created, expressed and explored (feasibility and viability). Within this (3.5) phase ideas are created either by (1) a specific innovation workshop with a guide and specific rules or (2) employees within their business unit (in particular research and development).

(1) Within the innovation workshop interdisciplinary teams are guided through the creative process by providing relevant information, gathering experience at the place (*Ort*) of relevance (for example the next shopping car has the place (*Ort*) such as parking spaces at shopping malls), focus on future possibilities and opportunities and creation and prioritisation of ideas by the group. The interactions between individuals have certain routines and rules such as starting with socialising of individuals (snacks and drinks), hierarchical order does not apply, everybody is heard, specific physical place and guide tries to help group members to open up to different perspectives and new ideas and solutions. This innovation workshop is a good example of creativity within the *Freiraum* (free mental, social, physical and regulatory space).

(2) The process of the orientation phase within business units incorporates meetings with middle management. Middle management acts as a connector of the strategic and operational level. In these meetings possible ideas are discussed. These discussions should be based on dialogue and require open discussions in which unusual ideas can be freely expressed and developed (social *Freiraum*). Risk-taking is also required to implement the creative concepts. This *Freiraum* can be produced by several leaders' practices as presented in Table 6-9 (next page).

| Leadership that produces / prevents *Freiraum* |
|---|
| **Facilitation** |
| Leaders can produce Freiraum by empowering individuals that they can self-determine, on which ideas/projects they want to work on and how to do this. The organisational vision can provide wide and open boundaries. Empowerment means providing resources (time and budget) for novel and unusual ideas. This results in challenging individuals to produce novelty, but not determine what to do and to do it. |
| Leaders should avoid straight judgment of ideas and providing little resources (time and budget) at the start to explore ideas ('auf kleiner Flamme') and see if the idea might be feasible and viable. This can be considered as a small (regulatory) *Freiraum*. As the project moves on more resources can be provided or the project can be stopped. Several innovations were produced by these projects underneath the 'strategic surface' within the research & advanced development department. |
| Leaders can produce *Freiraum* when they continuously appreciate ideas and opinions from their employees, which is socially rewarding (see sub-pattern 4-1). This allows speaking freely and therefore produces a social *Freiraum*. This requires accepting the perspective of others and might involve dealing with critique respectfully. |
| Furthermore, leaders need to 'take the load off employees' ('Rücken freihalten') e.g. defending the project in 'political discussions' that individuals can use their energy and concentration to create the many ideas that are required to develop inventions and produce innovations. This 'taking the load off employees' provides the *Freiraum* for creativity and innovation. An analogy for this might be a mother duck protects her chicks from danger so that they can play freely. |
| **Prevention** |
| Punishment prevents *Freiraum* to occur. The space of *Freiraum* will not be produced, if leaders punish their employees when making a mistake (e.g. stating too often problems to management), because individuals will not express and try unusual ideas anymore (no free social space) (see sub-pattern 4-2) and are not willing to take the effort to produce unusual ideas (no more mental *Freiraum*). This consequence is produced by a feedback loop as (mental/social) *Freiraum* is available at first, but after the punishment *Freiraum* is reduced or demolished, as individuals are not willing to produce new ideas and afraid to express and try unusual ideas. |
| In contrast to appreciation, leaders often focus and are enthusiastic about their own ideas or have made up their mind before the discussion (opinionated). This prevents firstly, the involvement of employees in the production of creative ideas, which is crucial as they need to develop and execute the idea. Secondly, it prevents open discussions. Therefore, social *Freiraum* within individuals' interaction cannot emerge and creation of novel ideas in which both strategic and operational perspective is taken into account is prevented. |
| Another prevention of the Freiraum in long-term is idea stealing. Idea stealing frustrates employees and decreases dramatically the willingness to implement the ideas and develop further ideas. The conditions for Freiraum to emerge might be available, but as a result of idea stealing employees are not willing to use their 'energy' to produce novel ideas and therefore do not use the *Freiraum* for creativity. |
| No support from leaders to implement ideas can decrease the motivation to make use of *Freiraum*. Not every idea can be implemented. Therefore, leaders need to explain why ideas cannot be supported. This has been linked by several interviewees to the practice of the value of appreciation (respect) by leaders. |

**Table 6-9: List of leadership practices that produces or prevents Freiraum (focus groups and interviews)**

### 6.4.3 *Conclusion to pattern 3: Vision, strategy and leadership*

The pattern identified the leadership practices and the regulatory space that allows the production of the space (*Freiraum*) in which creative ideas can emerge. The combination of (a) an open vision translated into a challenge, (b) empowerment of employees and (c) the time to produce, explore and provide new ideas (orientation phase) can build a dynamic of motivation and *Freiraum* (self-determination) that allows novel ideas to be created. It also allows the combination of the top-down and bottom-up processes. Within the orientation phase leaders and employees are required to take risks, willing to innovate and deal with uncertainty (reaction to mistakes). Otherwise, creative ideas are not created and implemented and over the long-term the individual and collective innovation willingness is decreased. This will be discussed in the next pattern.

## 6.5 Pattern 4: Innovation willingness and reaction to mistakes

The fourth pattern is the innovation willingness and reaction to mistakes. The pattern includes the themes of individual innovation willingness, collective innovation willingness and the reaction to mistakes. These three topics are recursively interacting as punishment can reduce the collective innovation willingness and the reduction of the collective innovation willingness can reduce the individual willingness. These dynamics within momentary situations can reduce the innovation willingness throughout an organisation and produce a so called 'dinosaurs company' (unable to adopt) as the willingness for change diminishes.

### 6.5.1 *Pattern elements*

The components of the context within momentary situation that drive the innovation willingness are captured in the pattern elements. The pattern elements identified through the survey analysis (PCA) are presented in Table 6-10.

| Relationship to innovation performance | | $r$ | $p$-value |
|---|---|---|---|
| 4.1 | (E.2) Openness to change | 0.484 | < 0.001 |
| 4.2 | (E.11) Intrinsic motivation | 0.389 | < 0.001 |
| 4.3 | (E.1) Open communication | 0.356 | < 0.001 |
| 4.4 | (E.12) Practice of shared values | 0.314 | < 0.001 |
| 4.5 | (E.10) Risk-taking | 0.260 | < 0.001 |

**Table 6-10: Presented variables of 'intellectual bin' of organisational behaviour and climate (PCA)**

The pattern elements within individual interactions identified in the focus groups and interviews data are presented in Table 6-11.

| Pattern element | | Description |
|---|---|---|
| 4.6 | Individual innovation willingness | The individual innovation willingness is the willingness of an individual to create new ideas. Individual innovation willingness incorporates intrinsic motivation and openness to change. |
| 4.7 | Freiraum (free social space) | The free social space provides a space in which unusual ideas can be expressed freely and individuals open up to change. |
| 4.8 | Appreciation by leaders | Appreciation of employees' ideas and opinions by leaders can produce interactions in which individuals feel rewarded and express opinions and ideas. |
| 4.9 | Social reward | The expression of own ideas and opinion within the collective can result in social reward. |
| 4.10 | No Stress | Stress from the environment can lead to the prevention of openness to change. |
| 4.11 | Level of freedom | The level of freedom provided by leaders and colleagues allows individuals the space to think (e.g. walk around the building). This dynamic matches the researchers' own experience in the company. |
| 4.12 | Collective innovation willingness | The collective innovation willingness is the basis for implementing novel and unusual ideas. (Table 6-12, page 222). |
| 4.13 | Reaction to mistakes | Reaction to mistakes such as punishment (e.g. the expression of problems in a project can lead to validate an individual negatively in his/her career validation LEAD (Leadership Evaluation And Development)). This leads firstly to not solving problems and secondly to not taking the risk to implement unusual ideas. Reaction to mistakes that improve the collective innovation willingness includes open communication, accepting problem and the fast learning of mistakes. |
| 4.14 | Acceptance of mistakes | Above all, the risk-taking involves open communication. This means willingness to take risks, willingness to make mistakes and the acceptance of mistakes. |
| 4.15 | Learning from mistakes | The creation of innovation includes a culture that allows the making of mistakes, to learn from the mistakes and the mistakes must be communicated in the sense that I have a problem. |

**Table 6-11: List of pattern elements of innovation willingness and reaction to mistakes (focus groups and interviews)**

### 6.5.2 *Pattern structure*

The pattern structure of innovation willingness and reaction to mistakes is presented in Figure 6-7 (page 224). This pattern comprises two sub-patterns. The first sub-pattern (4-1) identifies the dynamics of individual innovation willingness to generate creative ideas as presented in Figure 6-5. The second sub-pattern (4-2) examines the collective innovation willingness and the collective reaction to mistakes as presented in Figure 6-6 (page 221).

The first sub-pattern illustrates the dynamic that facilitates or prevents the motivation and openness to change of individuals.

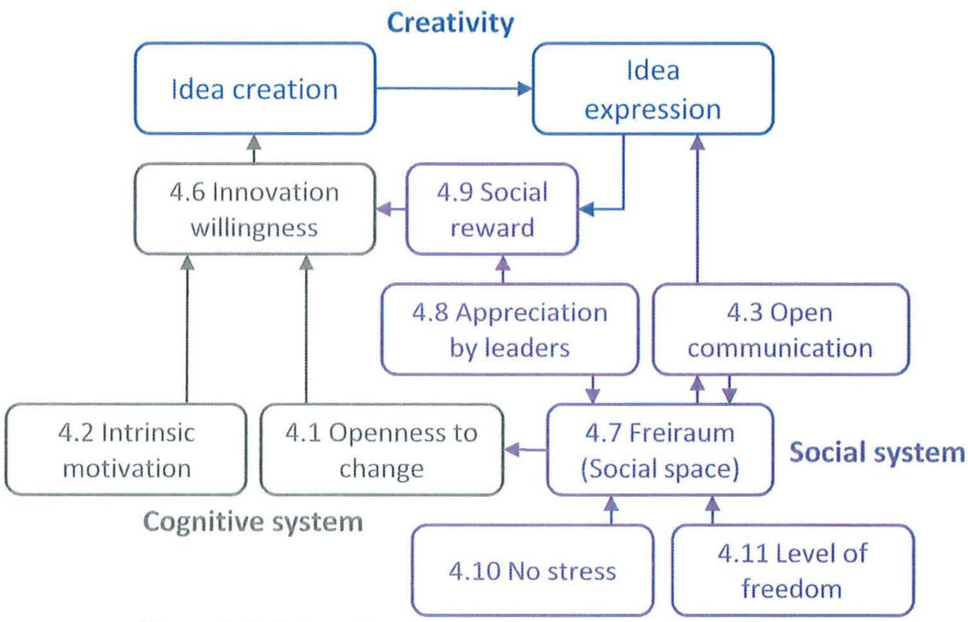


**Figure 6-5: Sub-pattern 4-1 – Individual innovation willingness**

The pattern identifies the interrelation between the individual and the social environment that can stimulate the innovation willingness. The first focus group stated this as following:

"The concepts [openness to change, intrinsic motivation and open communication] are the prerequisite to **try new things, to be open for innovation.**" [...] "This is the **innovation-willingness** and **willingness to take risks.**" (Focus Group 1)

Similar to the first group the second group pointed out that,

Person A: "The word **'open'** is used twice in the presentation. The opposite of open is 'closed' and this means that it seems somehow to be **closed** and **not open to**

**communicate**, **not open to change** and **not open to take risks**. But these are concepts, if I do not have them..."

Person B: "If I only feel **pressure subconsciously**, then I won't **change myself**, because I am going to stay in my safe harbour [comfort zone]." (Focus Group 2)

This indicates that firstly the innovation willingness is based on the individuals' motivation and openness to change. This (4.1) openness to change requires a (4.7) free space (*Freiraum*) of (4.10) no pressure and stress. Such stress free momentary spaces in which ideas spontaneously emerged have been stated by several individuals as the sitting on the toilet (as stated in pattern 1) or being under the shower. Within this *Freiraum* individuals open up to change and leave the 'safe harbour'. This allows them to explore opportunities and possibilities. This *Freiraum* needs to be constituted within conversation. This was pointed out as following:

Person A: "[...] it is essential that I have the **stimulus** that I can present myself. **Open communication** means I am able to bring up my own **appreciation** by **presenting my ideas** and this is already a **reward** for me. If this is practised in the right way this **openness facilitates innovation**."

Person B: "From my perspective, this **openness** to **new ideas** leads to the **advancement**."

Person C: "We are speaking continuously with our employees in our 'employee appraisal discussions' in team meetings. However there is not much openness to express ideas. The **more open we are approaching and listening** to the **employees' ideas and opinions** the more **reward** is involved, the more the **behaviour is improving**." (Focus Group 2)

The (4.8) appreciation by leaders through listening to employees' ideas and opinions produces a momentary situation in which ideas can be expressed and this is socially rewarding. This reward facilitates the innovation willingness to create, express and discuss creative ideas. Therefore, (4.8) appreciation by leaders and (4.10) stress free situations produce the (4.7) *Freiraum* in which (4.3) open communication emerges and individuals can express and discuss freely new and unusual ideas. Several interviewees emphasised that this does not mean speaking nicely, but rather addressing problems directly and expressing opinions and critique within a mode of dialogue. Furthermore, (4.7) *Freiraum* and (4.3) open communication are reinforcing each other and can produce a dynamic that leads a group into a collective creative mode (group creativity).

Secondly, *Freiraum* needs to be produced in daily interactions and routines. The second focus group stated this as the following:

"What we as managers need to do is **providing our employees the Freiraum** and it does not matter if somebody has a coffee break at nine or if he/she has a creative break at eleven in which he/she is walking outside around the building. These are the **Freiräume** [plural of Freiraum] in which **someone can become creative**."
(Focus Groups 2)

This implies that the production of a momentary *Freiraum* (free social space) in which individuals can be creative is determined by the (4.11) level of freedom granted by leaders and colleagues. Without this (4.11) level of freedom, one cannot produce one's *Freiraum*, if the social environment is not permitting it.

The pattern identified that (4.3) open communication, (4.11) no pressure, (4.8) appreciation by leaders and (4.3) open communication produces the (4.7) free space (*Freiraum*) in which individuals (4.1) open up to change and try new things. This (4.1) openness to change and (4.2) intrinsic motivation constitutes the (4.6) individual innovation willingness, which enables the engagement in the essential task (pattern 1, page 201) and acceptance of the challenge (pattern 3, page 212). This (4.6) individual innovation willingness can be reduced over time through the absence of (4.12) collective innovation willingness, which leads to the second sub-pattern (4-2).

The second sub-pattern (4-2) of collective innovation willingness and reaction to mistakes identifies the dynamics that determines the collective motivation to actualise and develop several ideas into invention and innovation. This is illustrated in Figure 6-6.

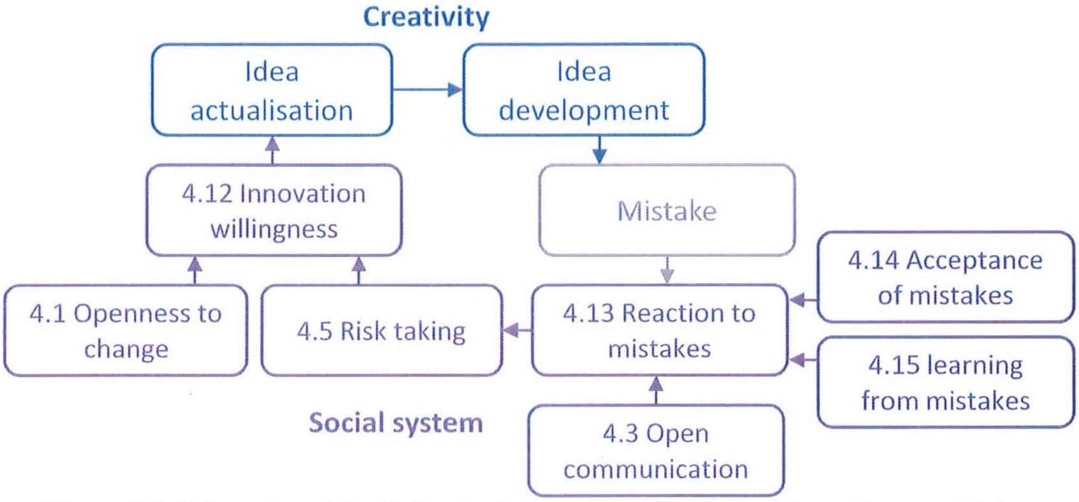



**Figure 6-6: Sub-pattern 4-2 - Collective innovation willingness and reaction to mistakes**

The individual innovation willingness (sub-pattern 4-1) is dependent on the innovation willingness of the collective. This has been pointed out by the second focus group as the following:

Person A: "The more I **want to change** the more I have to become **willing to take risks**. But my colleagues need to be more **open to deal with the change**."

Person B: "I cannot **advance myself**, if I do not deal with the other [person]. We are living in a **cross-linked system**, if I do not **speak with the other employees**, I will not **create something valuable**." (Focus Group 2)

This indicates that creativity within an automotive manufacturer, similar to other companies with complex products or services requires collaboration and co-creation and therefore (4.12) collective innovation willingness. Therefore, the several individuals involved need to (4.1) open up to change. The variable (E.2) openness to change has been identified as the variable with the strongest effect size in the Pearson's correlation analysis (PCA) with the innovation performance factor. The dynamics of (4.1) openness to change of individuals has been discussed in sub-pattern 4-1. Furthermore, the interview data revealed four key themes, namely 'idea selling', feasibility, 'Mitnehmen' (loosely translated as 'include somebody') and different interests that influence the implementation of concepts as presented in Table 6-12.

| Implementation of new concepts | |
|---|---|
| Selling of ideas to management | The bottom-up process of ideas implementation requires the selling of ideas to managers. Each idea needs a 'godfather' of the idea ('Ideenpate'), who provides the necessary resources to develop a prototype. This requires communication skills as well as supporting information. The problem of idea selling is that decision makers might not be interested in the idea for several reasons. Therefore, it can be difficult to get commitment for a creative idea. Within a large organisation ideas can be "sold" to several departments in case one manager is not interested, does not like the idea or is not willing to take the risk. Another approach taken to overcome the problem of idea commitment is an open idea portal in which every employee can express, discuss and rate ideas. Best rated ideas will be implemented (democratising innovation). |
| Feasibility | An initial idea requires social validation. Novel ideas can be valuable from one perspective, but another will identify an issue. Therefore, ideas are required to be validated by several experts ("the devil is in the detail"). This holds the problem of different interests involved and individuals might not be open to change. This is linked to the next item, the including of others ('Mitnehmen'). |
| Including others ('Mitnehmen') | Ideas need to match the mental (e.g. different interests), social (e.g. shared values) and organisational system (e.g. resources available) otherwise the idea is unlikely to be implemented or become a success. Therefore, to accomplish shared commitment, innovation willingness and make the idea feasible and viable one is required to <u>include</u> several experts and openly discuss impacts and possible solutions (idea development rather than idea communication). |

**Table 6-12: Dynamics of implementation of new concepts (interviews)**

The second pattern element, which drives the (4.12) collective innovation willingness, is (4.5) risk-taking. This has been stated as the following:

Person A: "The **creation of innovation** must be so 'ticklish' and must involve high **risk**. If you want to **stand out of the competition**, there must be **risk involved**. [...]"

Person B: "[...] and above all, the **risk-taking** involves **open communication**. This means **willingness to take risks**, **willingness to make mistakes** and the **acceptance of mistakes**." (Focus Group 1)

Similar, to the first group the second group stated:

"It is about **risk-taking**. Risk interrelates with the probability that something won't go according to plan." (Senior manager - Focus Group 2)

Innovation involves novelty by its nature and therefore includes uncertainty, which requires risk-taking. Therefore, the second attribute that constitutes (4.12) collective innovation willingness is (4.5) risk-taking. (4.5) Collective risk-taking is constituted by the social interaction of individuals that develop the novel concept. The focus groups stated that,

"The creation of innovation includes a culture that allows the **making of mistakes**, to **learn from the mistakes** and the **mistakes must be communicated** in the sense that I have a problem."

"It is about **risk-taking**. Risk interrelates with the probability that something won't go according to plan."

"This culture must be **practiced on a daily basis**, to create a **risk-taking culture. Otherwise you do not need to take any risk from the very beginning, because in the sum of it we are all interlinked**." (Focus Group 2)

Firstly, this implies that the dealing with uncertainty involves fast (4.15) learning from mistakes by (4.14) accepting the mistake and (4.15) communicating the mistake/problem. This allows (4.13) dealing with problems. Secondly, the relationship between (4.5) risk-taking and (4.13) dealing with problems is a feedback loop. On the one hand when (4.13) dealing with mistakes through (4.3) open communication and (4.15) fast learning this increases (4.5) risk-taking as leaders/employees have confidence in employees when (4.13) dealing with uncertainty. On the other hand when individuals are punished for mistakes even implicitly, (4.3) open communication is decreased and in the long-term (4.5) risk-taking, which ultimately decreases the (4.12) collective innovation willingness. The entire complexity of the feedback loops of reaction to mistakes to collective innovation willingness and to individual innovation willingness is presented in Figure 6-7 (next page).

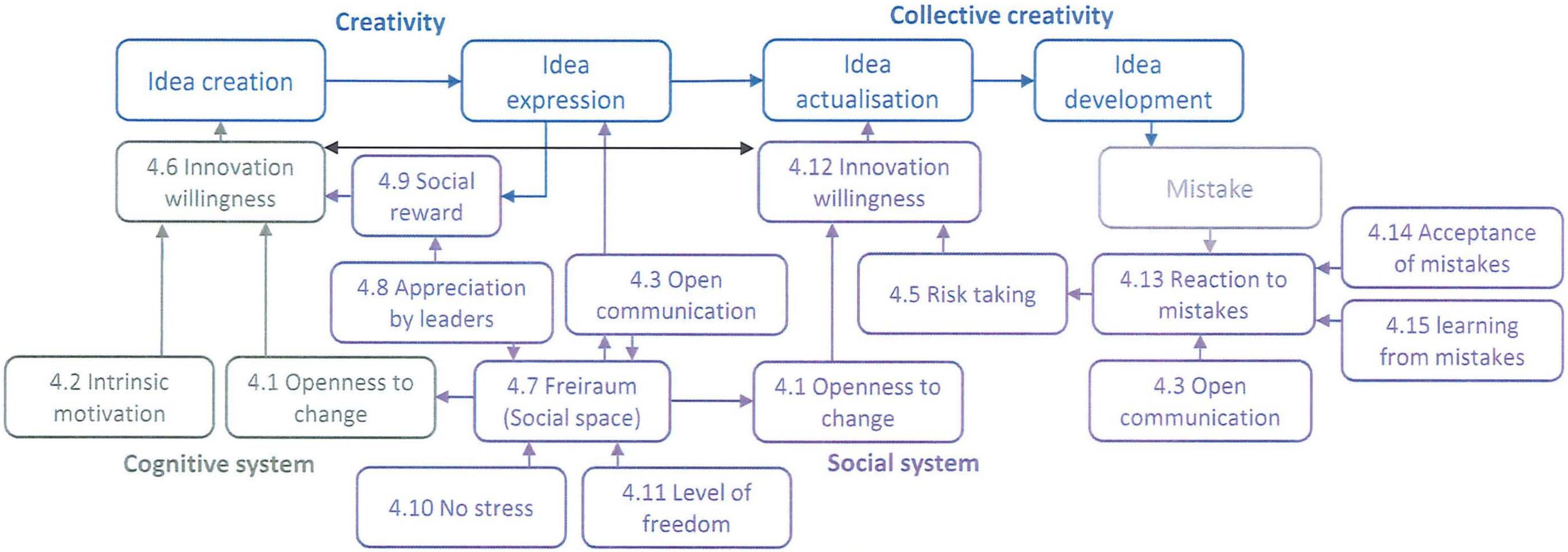



**Figure 6-7: Pattern structure of innovation willingness and reaction to mistakes**

### 6.5.3 *Conclusion to pattern 4: Innovation willingness and reaction to mistakes*

The two sub-patterns identified the dynamics of innovation willingness. The two patterns combined as presented in Figure 6-7 reveals that there are two feedback loops involved. For example, punishment can reduce collective innovation willingness, which leads to the reduction of the individual innovation willingness. These momentary events produce the larger organisational context (structure) of unmotivated employees ('Bewohner'). On the other hand dealing openly with mistakes can lead in the long-term to risk-taking, which produces individuals with high innovation willingness. This open communication that produces the innovation willingness is based on the ambience and social support, which will be discussed in the next pattern.

## 6.6 Pattern 5: Ambience and social support

The fifth pattern embraces the dynamics of the physical and social space that can facilitate the co-creation (pattern 2, page 204) within an organisation.

### 6.6.1 *Pattern elements*

The variables inherent in the 'intellectual bin' of organisational structure and workplace that build this pattern are presented in Table 6-13.

| **Relationship to innovation performance** | | $r$ | $p$-value |
|---|---|---|---|
| 5.1 | (F.3) Organisational structure enables social networking | 0.274 | < 0.001 |
| 5.2 | (F.1) Interdisciplinary team structure | 0.269 | < 0.001 |
| | (F.5) Interdisciplinary team learning | 0.262 | < 0.001 |
| 5.3 | (F.7) Workplace allows thinking and concentration | 0.257 | < 0.001 |
| | (F.9) Workplace allows creative working | 0.229 | < 0.005 |

**Table 6-13: Presented variables of 'intellectual bin' of ambience and social support (PCA)**

The pattern elements of (5.1) organisational structure that facilitates social networking and (5.2) interdisciplinary teams (group composition) are closely linked to dynamics of the pattern 2: Co-creation (page 204). Additionally, the variable (5.3) workplace was identified as being influential on innovation with a relationship of nearly a middle size effect (PCA). The pattern elements that build the dynamics of the ambience and social support, which allow creativity to emerge, are presented in Table 6-14.

| Pattern element | | Description |
|---|---|---|
| 5.3 | Ambience | The ambience is the physical work environment in which informal conversation can occur. Such physical spaces have been stated as coffee corners, events of informal exchange, and informal exchange during lunch time. This ambience facilitates social interaction and knowledge creation. |
| 5.4 | level of freedom | "The level of freedom which someone gets from his/her surrounding such as his/her boss." This level of freedom allows individuals to self-determine their actions. |
| 5.5 | Support behaviour | The freedom to produce ideas is also dependent of the social support by peers. "We are all dependent on other's expertise and therefore are dependent on each others'" social support. |
| 5.6 | Freiraum | The Freiraum is both a physical space in which individuals can exchange ideas and the social space in which individuals are allowed to think or exchange ideas freely. |
| 5.7 | Dialogue | The social interaction is influenced by the physical and social environment (see above). Smoking areas, coffee corners and birthday events have been reported as facilitators of dialogue. |

**Table 6-14: List of pattern elements of ambience and social support (focus groups and interviews)**

### 6.6.2 *Pattern structure*

Ambience and social support is closely linked to co-creation (pattern 2) as illustrated in Figure 6-8.

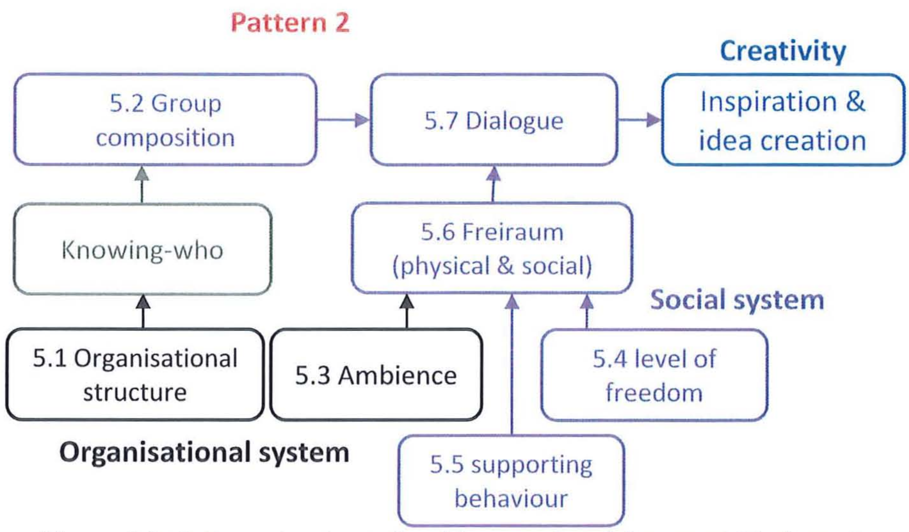



**Figure 6-8: Pattern structure of ambience and social support (Freiraum)**

Figure 6-8 shows the patterns of co-creation (page 204) and the pattern elements of (5.1) organisational structure, (5.3) ambience and (5.4) (5.5) social support that facilitate the co-creation. This dynamic has been stated as following:

"... what we observe with our construction engineers is that they **draw back** with a cup of coffee and meet **in the kitchen**, and there they start **discussing** about technology, and in these **discussions new ideas suddenly occur** and then somebody says **this is a good idea, I am going to try this**." (Senior manager - Focus Group 2)

This indicates that the (5.3) ambience such as coffee corners/places in which individuals can have informal discussions facilitate co-inspiration and creativity. Similar, the first group stated that,

Person A: "The individual working space may not need to be so great. For example the smoking area, which we do not have anymore, there was much more communication without coffee, you must say this."

Person B: "The **coffee corner** does not work as good as the smoking areas, for sure."

Person A: "Much better were the **birthdays with wine**. This is actually **facilitating creativity** as a bit of alcohol helps to switch off some barriers such as taking risk."

Person C: "It is the **ambience** and not the individual working space."

Person A: "[...] if a single individual is not able to produce the same thing as what the collective is able to produce then we need to create the **work environment in such a way that the individuals can exchange knowledge**."

Person B: "I am seeing this the same way. I was recently in the research centre in Ulm and the **ambience** is different. I can see that there is **creativity promoted**. The individuals are meeting there for communication and exchange [of ideas]." (Focus Group 1)

This indicates that the (5.3) physical place or ambience in which knowledge can be informally exchanged can facilitate the generation of creative ideas and solutions. The (5.3) ambience that allows new discussions and (5.7) informal knowledge exchange within a certain spatial proximity can produce a space in which creativity can emerge within individuals' interactions. For example, individuals act context specific to the environment and coffee corners are designed to communicate and drink coffee. Therefore, (5.6) physical spaces should be associated with creative acting such as speaking freely, so that creative interactions can emerge. The physical space alone does not produce creative conversations. The first group stated that, "The **level of freedom** which someone gets from his/her surroundings and **one's boss or colleagues help**, not only the well-being through the physical space." (Senior Manager - Focus Group)

This indicates that the (5.6) *Freiraum* (physical space) is also a social construct of the individuals around the produced space and the individuals within the space. The individuals outside the *Freiraum* are required to provide the (5.4) level of freedom, that individuals can establish this creative space, while the individuals within the space are required to (5.5) support and help each other so that the interactions will result in (5.7) dialogue.

### 6.6.3 *Conclusion to pattern 5: Ambience and social support*

The pattern indicated the dynamics that are conducive to the production of the space in which creativity can emerge (*Freiraum*). In addition to the physical and social influences, there is the regulatory influence and the shared understanding of work that influence the individuals' interaction to produce creativity.

## 6.7 Pattern 6: Regulatory, social and cognitive influences on time spaces

The pattern of regulatory, social and cognitive influences on time spaces examined the influences within the dilemma of exploitation and exploration. This pattern identified that certain organisational processes and shared 'comprehension of work' can prevent or facilitate either exploitation or exploration.

### 6.7.1 *Pattern elements*

The pattern element identified by the quantitative analysis is (6.1) time resource to develop ideas as presented in Table 6-15.

| Relationship to innovation performance | | $r$ | $p$-value |
|---|---|---|---|
| 6.1 | (G.3) Enough time to develop ideas | 0.313 | < 0.001 |

**Table 6-15: Presented variables of 'intellectual bin' of regulatory and social influences of space of time (PCA)**

The pattern elements related to the variable presented in Table 6-15 are presented in Table 6-16.

| Pattern element | | Description |
|---|---|---|
| 6.2 | Time pressure | Time pressure makes it difficult to solve a problem creatively. Time pressure prevents the observation and exploration of opportunities and phenomena outside the work routine. |
| 6.3 | Work routines (workload) | Work routines and workload can reduce the time to work creatively. Workload has been stated as resulting in an environment in which everybody is executing their own routine and not willing to support somebody outside this routine. |
| 6.4 | Organisational structure and processes | Creativity within a clocked operation, the highest synchronisation designed routines is very difficult as an extra time space can have the consequence that the entire process slows down. Therefore, a regulatory system should incorporate the flexibility of time spaces within the process (redundancy of time) or a separate process to explore and produce ideas. |
| 6.5 | Comprehension of work | 'Time to think' is often not accepted as working, therefore individuals are criticised when they take the 'time to think'. |
| 6.6 | Freiraum (time frame & social space) | Freiraum is the time space in which individuals can freely work creatively and think creatively. This space within working hours is facilitated or prevented by the work processes (e.g. highly clocked) and the social comprehension of work. |
| 6.7 | External environment | External events such as the credit crunch in 2008 can result in the reduction of time and financial resources and therefore can reduce the Freiraum to explore new ideas. On the other hand, it was stated that such events can increase the willingness to change (innovation willingness). |
| 6.8 | Financial resources | Financial resources are required to be able to explore opportunities, create novel ideas and implement the ideas. |

**Table 6-16: List of pattern elements of regulatory and social influences of space of time (focus groups and interviews)**

### 6.7.2 *Pattern structure*

The pattern structure identified the dynamics that determine the Freiraum of creative thinking as illustrated in Figure 6-9.

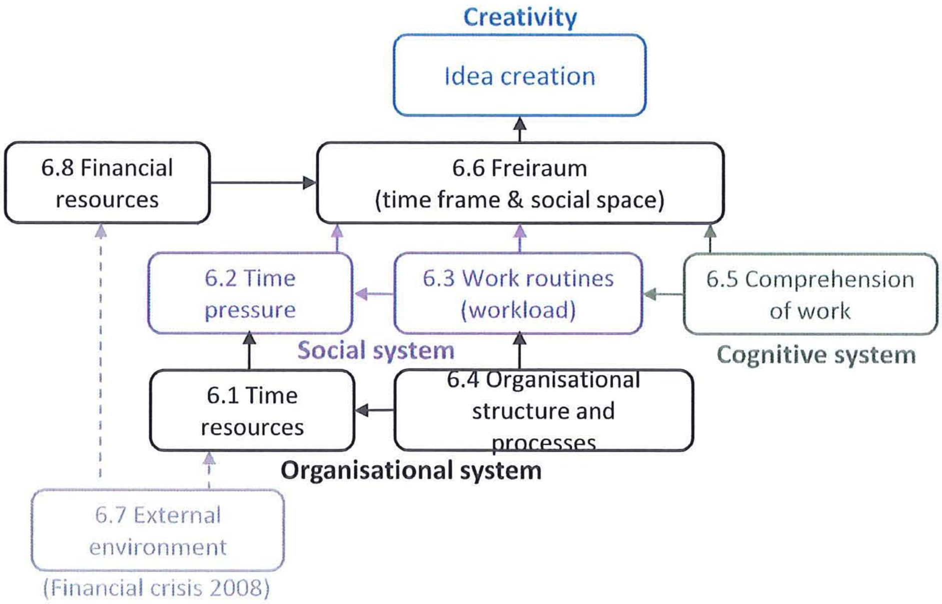



**Figure 6-9: Pattern structure of regulatory and social influences of space of time**

As illustrated in Figure 6-9, (6.1) time resources and (6.3) work routines can result in (6.2) time pressure or in a (6.6) time space (*Freiraum*) in which creativity can emerge. This has been stated as following:

Person A: "I have the impression that creativity only arises, if the time space is available. The more an employee is **under pressure** to meet a certain goal, he/she has not the Freiraum, to **get free from the actual business** [daily work routines], **creativity is thereby decreased.**"

Person B: "So you think of **time as a muse**, and not that it may take a long time for someone to get [creative] innovative."

Person A: "Yes! We know also from research that a person who is **under stress** and should solve some problems results in that he/she **solves them worse than someone who has the time.**" (Focus Group 1)

This implies that creativity occurs within momentary events (space) of (6.2) pressure free moments and (6.3) acting outside the work routines. Several interviewees have answered the question, "when did you create the best ideas?" with "by going (6.3) outside the routine or taking employees out of the routine and executing a (6.6) two or three day creativity workshop in which they could identify, define and solve the problem independently. This (6.3) 'out of the routine' is the (6.6) *Freiraum* (free space) in which creativity can emerge. The production of *Freiraum* is difficult within organisational processes (regulatory space), which are designed for efficient (exploitation). The focus groups stated this as the following:

Person A: "This is why the factor time is crucial in terms of the organisation design." [...]

Person B: "The 'time frame' needs to go hand-in-hand with the MDS [Mercedes-Benz Development System]."

Person C: "If I expect that within the MDS, within this clocked operation, the highest synchronisation designed routines, built-in time zones where one or the other says, wait, **I was at this moment in my creative zone, everybody will respond that this person is insane.** I see this as very critical. I think that this free time must be kept free for the individual or the group to deal with creative topics in addition and besides the MDS."

Person C: "I have the opinion that the MDS is a clocked process, which is clocked in such a way that the latest topics can be brought to the market fast and an organisation needs an additional independent second process, which is not product-orientated and permits a solid rhythm to deal with creativity and innovative ideas throughout the year." (Focus Group 1)

This implies that within a regulatory space that has a 'clocked' process (high efficiency) prevents the production of *Freiraum*. For the production of *Freiraum* within the regulatory system there are two ways. Firstly, a second process/structure (ambidextrous organisation) in which the *Freiraum* can be produced. Secondly, through a redundancy of time (certain time flexibility) within the 'clocked' process that allows the production of *Freiraum* and exploration within the process (contextual ambidexterity). The problem with producing *Freiraum* within the normal work routines is an issue of shared perception (mental space), stated as the following:

Person A: "If you remember some time ago that it was the vision that we can unburden the employees with the workload, a **fifth of the time of a group** that they can **spend one day to deal with creative topics**."

Person B: "This is funny. We have discussed this in the last department meeting. We have said that we want the employee freeing, let's say 10 % of his/her capacity, that he/she has the time to think." [...] (Focus Group 1)

Person A: "But at the moment we do not have the time."

Person C: "In any case we use the **time to work** ... when we have a **free time space**." (Focus Group 1)

This implies that when the regulatory system allows producing the time space, (6.3) workload and the shared (6.5) 'comprehension of work' can prevent the production of *Freiraum*. Working is often perceived as 'doing things', while acting outside these work routines in a relaxed or playful way is not perceived as working. The problem is that *Freiraum*, by its nature, is a space of thinking, exploring and creating, outside the work routines. Therefore, for the production of *Freiraum*, the space of thinking, exploring and creating, outside the work routines must be (6.5) perceived as working.

In addition, limited available (6.8) financial resources can have the consequence of preventing individuals from exploring new opportunities. This has been touched on as the following:

"The problem is that we do not have the time, money nor the resources anymore. The world was different before the financial crises [2008]." (Focus Group 2)

This finding implies that events such as the 2008 credit crunch can result in the reduction of (6.8) financial resources available, which leads to the reduction of working hours, labour and reallocation of resources, which results in inconsistency of the strategy (as examined in pattern 3, page 210) and ultimately the reduction of *Freiraum*.

### 6.7.3 *Conclusion to pattern 6: Regulatory and social influences of space of time*

The pattern showed that the regulatory (process and budget) as well as the social and cognitive system can prevent or facilitate the production of the space in which creativity can emerge. The next pattern discusses the communication behaviour that produces or prevents local spaces of creativity.

## 6.8 Pattern 7: Communication behaviour

The pattern 7 identified the communication behaviour that influences creativity within individuals' interactions. Three different communication behaviours, namely, communication over IS/IT, formal meetings and dialogue have been examined.

Repeating communication behaviour can produce the structure of the organisation (large organisational context), which results in information overload or can facilitate creativity.

### 6.8.1 *Pattern elements*

The organisational communication behaviours with a noticeable positive relationship with the innovation performance (survey analysis) are presented in Table 6-17.

| **Relationship to innovation performance** | | $r$ | $p$-value |
|---|---|---|---|
| 7.1 | (H.11) Ideas are created in dialogue | 0.444 | < 0.001 |
| 7.2 | (H.9) We have tools to analyse great amounts of data/information | 0.391 | < 0.001 |
| 7.3 | (H.7) Regular formal meetings with colleagues from other divisions | 0.284 | < 0.001 |

**Table 6-17: Presented variables of 'intellectual bin' of communication behaviour (PCA)**

The variables in Table 6-17 identified at the macro level influence the micro level. The pattern elements of the local context (micro level) that influences creativity within individuals' interactions are presented in Table 6-18. These pattern elements are linked to the pattern elements of information overload (pattern 1, page 199) and dialogue (pattern 2, page 204).

| **Pattern element** | | **Description** |
|---|---|---|
| 7.1 | Dialogue | Dialogue enables individuals to freely discuss problems and express unusual ideas and own opinions. It facilitates the sharing of experience and insights and mutual inspiration (see pattern 2, page 204). |
| 7.3 | Formal meetings | Formal meetings are required to include and inform several individuals in different departments. This meeting behaviour can lead to information overload. This is generated by the collective repeating behaviour of formal meetings. |
| 7.4 | Communication over IS/IT | Information overload leads to the distraction of the essential task (see pattern 1, page 199). |
| 7.5 | Knowing-who | Personal networks ('knowing-who') enables individuals to establish discussions and small groups to create new and appropriate knowledge (pattern 2, page 204). |
| 7.6 | Trust | Trust is the social condition, which enables a collective to permit individuals Freiraum and to speak one's own opinion and new ideas freely (e.g. trust that ideas won't be stolen; trust that individuals can achieve challenges, etc. - Table 6-19, page 236). |
| 7.7 | Freiraum | We are monitored from the beginning to the end by monitoring tools. This lack of trust prevents the production of Freiraum. |

**Table 6-18: List of pattern elements of communication behaviour (focus groups and interviews)**

## 6.8.2 *Pattern structure*

The pattern structure illustrates the possible effects of repeating behaviour within situations of individuals' interactions. This pattern is presented in Figure 6-10.

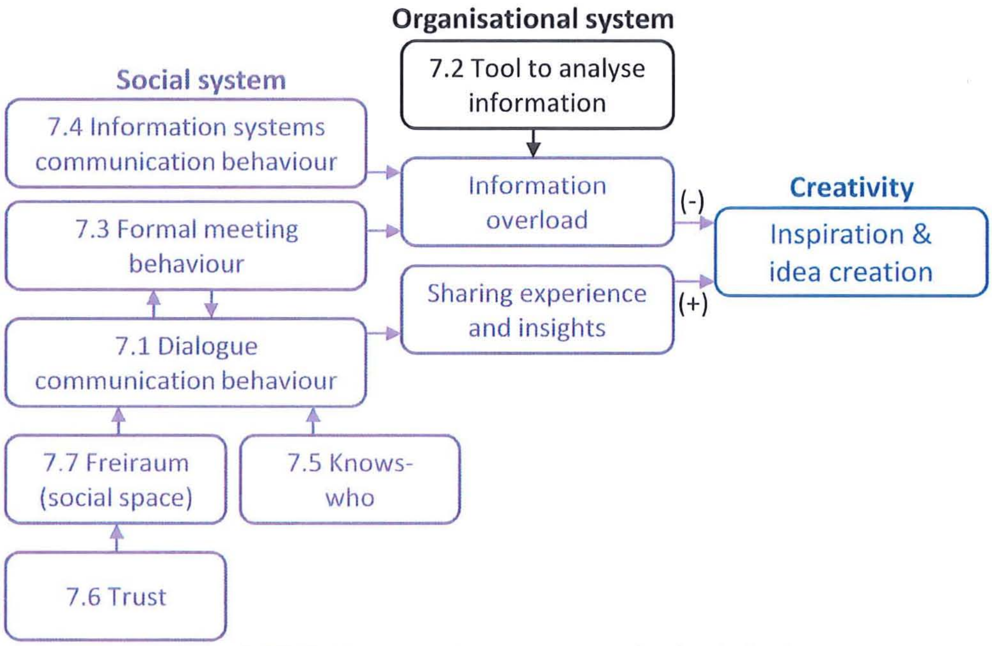



**Figure 6-10: Pattern structure of communication behaviour**

The first dynamic within the pattern is the communication behaviour that results in information overload. This has been pointed out as the following:

Person A: "We have **too many meetings** and therefore **not enough creativity**, because this silences everything as we sit in **meetings** with a large amount of image-performance [PowerPoint presentations]."

Person B: "We have too many **formal meetings**."

Person C: "Exactly! **10 meetings and 160 emails per day**."

Person A: "Yes the amount of emails is also an expression of it. But for us senior management it is the issue of **meetings**. We are not able to work with the **team on the essential topics**. This is the problem. The team is also **increasingly overloaded** with the **meeting culture**." (Focus Group 2)

Similar to the second group the first focus group stated that,

"The topic with the **large amount of data** that we have already discussed in the beginning, which is the topic of **information overload**. This must be reduced." (Director of Engineering - Focus Group 1)

This implies that recurring interactions based on (7.4) communication over IS/IT and (7.3) formal meetings can result in information overload, which prevents creativity within the organisation. In contrast to (7.3) formal meetings, the first focus group stated the importance of (7.1) dialogue.

"The topic of **dialogue** is much more important than the topic of media and databases. It is in fact that it results in a better innovative outcome if someone **talks to someone** instead **sharing information through email.**" (Director of Engineering – Focus Group 1)

As discussed in pattern 2 (page 204), (7.1) dialogue facilitates creativity within interactions of individuals. The communication over IS/IT and formal meetings might not facilitate creativity, but is required for the 'matching of actions' ('abstimmen') within a large organisation as emphasised by several interviewees. Therefore, both types of communication are necessary. Formal meetings and IS/IT communication are required to adjust and synchronise actions, while dialogue is needed when facing a problem in the, for example, development, production, maintenance and quality that requires creativity and when creating new ideas for innovation. The challenge is that this cannot be planned as nobody is able to foresee when a problem occurs within the, for example, development or production of a product. Therefore, the spaces of dialogue (*Freiraum*) need to emerge dynamically and self-organised. This requires that the environment (large organisational context) permits *Freiraum* (collective mode of dialogue) to occur, within tight structured processes that problems can be solved creatively. This has been related to one's personal network and (7.6) trust. The focus groups stated,

"In my view, what is really important is the **personal networks** that someone has, which **cannot be established through formal meetings**, but rather one **knows** and **trusts** someone with who he/she can talk with and then 'it clicks'." (Senior manager – Focus Group 1)

Similarly, the second focus group pointed out that,

"If we take this [meeting culture] into account then we have to take into account the **culture of mistrust**. We are **clocked from the beginning to the end by monitoring tools**. The **lack of trust** should be considered in the communication behaviour." (Focus Group 2)

This implies that (7.6) lack of trust leads to control, which prevents the (7.7) space of self-determination (*Freiraum*) to be produced and prevents the dialogue to occur. Trust has been pointed out by several interviewees as presented in Table 6-19.

| **Trust** |
|---|
| A shared empathy facilitates trust and allows better collaboration. |
| Leaders are required to trust their employees otherwise they have to produce reports continuously and cannot concentrate on the task to produce a creative solution. |
| Innovations were produced because leaders trusted their employees and this empowered them to perform creatively. Trust is the basis for empowerment. |
| Trust is required for innovation that nobody is stealing an idea. |
| Trust includes trusting employees that they are able to do their job and that they are doing it right in their way. |
| As soon as everything is monitored, because of the lack of trust that employees perform in the best interest of the company, there will be innovation produced. |
| Teams are required to trust their leaders. Otherwise there is no expression of opinions and ideas (communication of filtered information). Furthermore, individuals are not motivated to act (e.g. execute a task or produce a new idea). |
| If I know the goal or objective of somebody, I can support him/her. This is based on the culture of trust and cooperation. |
| Trust is the most valuable capital an organisation can and must have. |
| Consistency is a building block for trust. Therefore, constancy to support creativity results in trust. |
| Risk-taking facilitates trust as decision makers show trust in their employees. |

**Table 6-19: List of key findings of trust (interviews)**

### 6.8.3 *Conclusion to pattern 7: Communication behaviour*

The pattern identified that certain communication behaviours such as continuous repeated communication in formal meetings and over IS/IT can prevent creativity. Furthermore, the (7.6) lack of trust results in standardised processes and monitoring of individuals, which prevents (7.7) space of self-determination and dialogue (*Freiraum*). Furthermore, the integration of many individuals with many interests and responsibilities within a large organisation requires designed processes. Throughout this process, self-organised spaces (*Freiraum*) need to emerge dynamically so that individuals can be creative to produce new inventions, solve quality problems or produce an innovative marketing and sales strategy to achieve successful innovation. Within processes and chains of momentary events (spaces) of daily action and interaction, new knowledge needs to be created to produce creative ideas and solutions. This is examined in the next pattern.

## 6.9 Pattern 8: Spaces of knowledge creation

The pattern of spaces of knowledge creation embraces, firstly, the knowledge creation within different spaces, namely, virtual (IS/IT), social (conversations) and physical (at the place - *Ort*). These spaces are not mutually exclusive. This is presented and discussed in sub-pattern 8-1. Secondly, the pattern identifies two different spaces necessary for creativity, namely, *thick of the action* ('im Geschehen sein') and *Freiraum*. This dynamic was examined in sub-pattern 8-2. This section discusses the two sub-patterns and their dynamics in relation to creativity within individuals' interactions.

### 6.9.1 *Pattern elements*

The Pearson's correlation analysis (PCA) revealed that the knowledge creation routines that have a positive relationship with the innovation performance are knowledge creation (8.1) at the place of incidence ('vor Ort') and (8.2) through conversations as presented in Table 6-20.

| **Relationship to innovation performance** | | $r$ | $p$**-value** |
|---|---|---|---|
| 8.1 | Knowledge creation at the place of incidence | 0.397 | < 0.001 |
| 8.2 | We are acquiring knowledge through face-to-face discussions | 0.330 | < 0.001 |
| | Knowledge is sharing with other teams in meetings | 0.269 | < 0.003 |
| 8.3 | Knowledge creation through the use of IT-systems | 0.125 | 0.128 |
| | Exchange knowledge through IT-systems | 0.015 | 0.858 |

**Table 6-20: Presented variables of 'intellectual bin' of Knowledge creation routines (PCA)**

The correlation between knowledge creation (8.3) through IS/IT (virtual space) and innovation performance is not reliable. Nevertheless, the variables were presented to the focus group to examine, if they link the different spaces of knowledge creation to creativity. The identified pattern elements of the focus group discussion are presented in Table 6-21.

| Pattern element | | Description |
|---|---|---|
| 8.1 | At the place of incidence (*vor Ort*) | Knowledge (experience) is created 'at the place' (*vor Ort*) of the assembly line, customer, incidence, competitor, etc. This knowledge creation at the place enables a better understanding of the problem, demand, phenomenon, etc. This allows experiencing (in the thick of the action), which is vital for the idea creation. |
| 8.4 | Experiencing | Experiencing is the creation of experience through executing (doing or acting) and involvement in the action relevant to the task (knowledge-in-action). |
| 8.5 | Sharing of past experience | Sharing of experience in dialogue (see pattern 2 on page 204) |
| 8.6 | Information overload | Information overload was discussed in pattern 1 (page 199). |
| 8.7 | Information | Provision of information through IS/IT |
| 8.8 | In the thick of the action | In the thick of the action can be while doing routine work or by observing at the place (see item 8.1 above). |
| 8.9 | Freiraum | *Freiraum* is the free space in which individuals can self-determine their action and have the time and resources and social support to experiment and create new ideas. It also facilitates individuals to open up to change. (*Freiraum* has been discussed throughout this chapter) |

**Table 6-21: List of pattern elements of spaces of knowledge creation and change (focus groups and interviews)**

### 6.9.2 *Pattern structure*

The first sub-pattern includes the different spaces or routines of knowledge creation. This sub-pattern is presented in Figure 6-11.

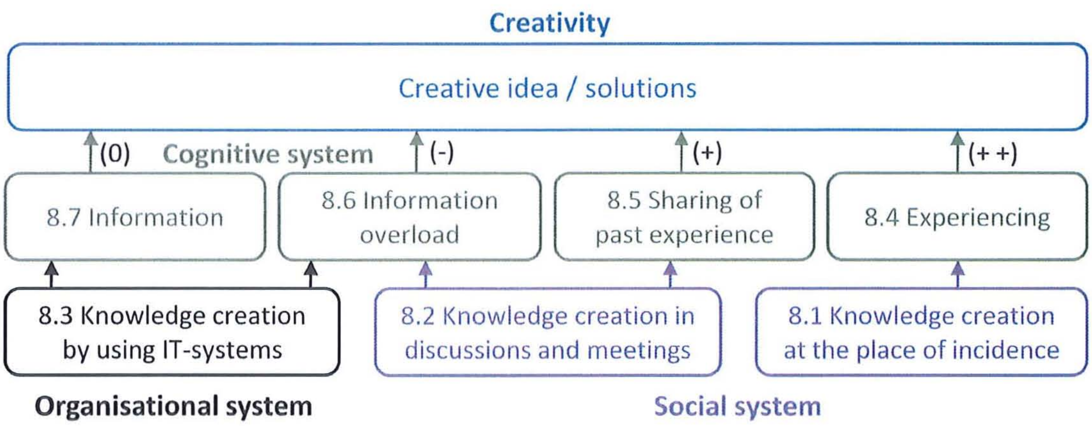



**Figure 6-11: Pattern structure of sub-pattern spaces of knowledge creation**

The sub-pattern presented in Figure 6-11 includes the knowledge creation through the virtual space (IS/IT), social space (conversation) and physical (at the place, *vor Ort*). The first focus group stated that the knowledge creation at the place of incidence (*vor Ort*) is conducive to creativity, while social space (conversations) is important and the virtual space (IT/IS) is not necessarily conducive. This has been stated as the following:

"Knowledge creation through **IT systems** is **stupid**. **Acquiring knowledge through 'direct conversations' is very important** and the **'learning at the place of incidence' is my favourite topic**. The **knowledge transfer** should be happening **at the place of incidence** instead of in a **meeting**. I go to the factory where it happened. [Analogy:] If something has fallen on someone's head, they look at your head together and **observe** where did it hit the head and where did it come from, **away from the meeting atmosphere** to the **place** where the **topics really happen**." (Director of Engineering - Focus Group 1)

This indicates that (8.1) 'being at the place' (for example customer spaces, shop floor, different countries) allows the creation of knowledge (experience) that is conducive to creativity. Furthermore, (8.2) conversations (social space) at the (8.1) place of incidence (physical space related to the topic) provide a space outside the work routine (different atmosphere). In contrast, virtual spaces (IS/IT) are seen as rather unsupportive for creativity. Similar, the second focus group stated that,

Person A: "I can create **factual knowledge** through **IT-systems** by database enquiries. But the **creation of knowledge towards creativity is for me the topic of experience**. This **experience** has been created through many years of **'being in the thick of action'** in relation to the product and **being involved** within the operations of the organisation. Maybe I am viewing this too much from the management perspective, but I don't think that **this knowledge is generated by the use of IT-systems.**"

Person B: "When we are talking about **creativity and innovation** then IT-systems are only a vehicle. A good engineer needs to know-how to use the CAD-system [Computer aided design] to produce a valuable outcome in time."

Person C: "I had a colleague, who could produce an innovation on the drawing board. He recognised what the problem was and recognised the solution. The reason why he could produce innovation was because he had the **experience**, **imagination**, the **time space to produce it** and **no distraction from the task**." (Focus Group 2)

This indicates firstly, that (8.1) '*being at the place*' in momentary events and over many years of *being in the thick of it* ('im Geschehen sein') produces (8.4) experience, which is the knowledge creation that is conducive to creativity. (8.4)

Experience and (8.1) 'being at the place' (*vor Ort*) has been stated by several interviewees as presented in Table 6-22. Experience and experiencing have been stated 231 times, which makes it one of the more frequently expressed themes.

| **Experience and at the place (*vor Ort*)** |
|---|
| Nobody can express it (e.g. phenomenon) better than those who were in the thick of it and experienced it. |
| Important for innovation are the individuals who worked in the thick of it (e.g. in the workshop, sales branch, at the assembly line) |
| The experience is input for new ideas, new ideas are created out of experience and experience is required to develop the new idea. |
| Experience in different countries is required to understand the customer demands there (Weltbürger - cosmopolitan) |
| A health relationship to experience is required to produce valuable ideas. |
| To solve the problems experience is required. |
| To avoid problems in the development and implementation phases as experience is required in the strategy phase (idea development). |
| Experience of the system (within the thick of the organisation) is required to develop ideas that will be successful within the system. Without experience the novel idea might not fit the system and will result in failure. |
| Not everybody can experience everything therefore the exchange of experience is required at best at the place of incidence. |
| Experience can prevent failure and problems. |
| Innovation requires utilising experience and going new ways. |
| One is required to go to the place and stay there to generate this deep knowledge (experience). |
| Ideas for innovation can be produced by gathering different experiences and bringing them together. |
| Experience can facilitate and prevent at the same time communication, because we match our observations with our existing mental categories. (problem of overcoming fixation) |
| Often it is the matching of experience of different individuals, which gets close to the solution like a spiral. |

**Table 6-22: List of key findings of experience and 'at the place' (*vor Ort*) (interviews)**

Experience (at the place / in the thick) is vital for innovation as it allows the production of feasible and appropriate ideas and is required to validate a novel idea. Experience can to some extent prevent problems and failure, but can also prevent the implementation of ideas, if ideas are not explored at best '*at the place*' (new experience). The relationship between '*at the place*' (*Ort*) and experience leads to the second sub-pattern (8-2) space of knowledge creation (*in the thick of the action*) and space of creative ideas and change (*Freiraum*). This sub-pattern is presented in Figure 6-12.

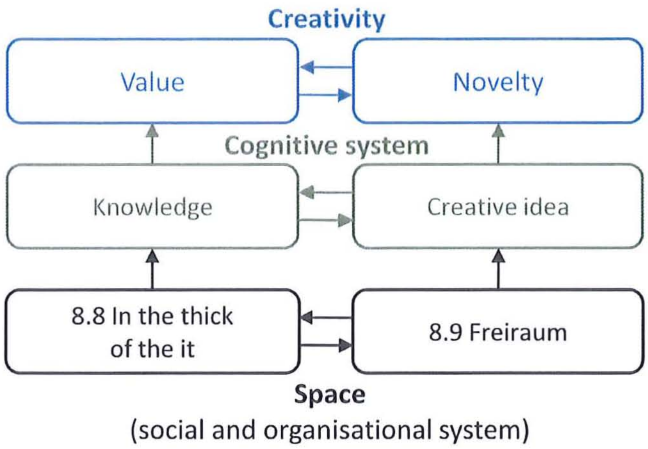



**Figure 6-12: The pattern structure of spaces of knowledge creation (in the thick of it) and change (Freiraum)**

Figure 6-12 illustrates the two spaces of (8.8) *in the thick of it* and (8.9) *Freiraum*. The (8.8) '*thick of it*' or '*thick of action*' ('im Geschehen sein') relates to the knowledge creation, while the (8.9) *Freiraum* relates to the access and utilisation of the knowledge into a creative idea, solution, concept or action. The second focus group stated this as follows:

Person A: "To be creative you need to **know what is going on in the environment**, **knowledge about product technologies**, **peripheral knowledge** and what else is available. Without **being involved in these things** it will not result in a creative outcome. But you need to define the frame of **being involved in the action** and the **time frame (Freiraum)** in which every engineer is **freed**..."

Person B: **"This is the unbelievable thing. This summarises it. An individual need to be in the thick of the action, but needs the time to think."**

Person C: "If you have a meeting culture of **too many formal meetings**, this will **kill creativity**. Definitely, it is not possible to be creative in such an environment."

Person D: "What we identified is that the **drawing back out of the work routines** for one or two days with the employees [into Freiraum] enables creativity. Creativity workshops with the interdisciplinary experts **away from the normal work routines** will result in the generation of innovation."

Person C: "Within the **normal work routines** with very few short breaks **it is very difficult to come up with a creative solution**, that is the problem." (Focus Group 2)

This indicates that the creation of knowledge about several phenomena, themes, objectives (for example customers, products, operative processes, outside knowledge of the domain) by *being in the thick of it* is a necessity and prerequisite for the creation of creative ideas (novel and valuable). For the utilisation of the knowledge, in particular, experience requires *Freiraum*, in which creative ideas and solutions can be created. This has been discussed throughout this chapter.

Furthermore, ideas are created in creative-workshops (*Freiraum*), while bringing these ideas back into action (development and implementation) is executed through processes. The focus groups pointed out that,

"We **create the initial idea through creativity-workshops** and so forth. As soon as the **idea exists, the formal progresses from idea to product** are established with milestones and so forth." (Senior Manager - Focus Group 2)

This indicates that the institutionalisation of *Freiraum* (creative workshops) can systematically facilitate creativity. The implementation of the creative idea back into the work routine (*being in the thick of action*) is institutionalised through processes with milestones. This is the process of bringing back the idea into the *thick of the action*. This process has been stated by several interviewees and will be discussed in detail in section 7.3 (page 296).

### 6.9.3 *Conclusion to pattern 8: Spaces of knowledge creation*

The pattern identified that knowledge creation is conducive to creativity is experience, which is created '*at the place*' (*vor Ort*). Furthermore, the exchange of experience in conversations, especially, in modes of dialogue (social space) facilitates creativity. It seems that the knowledge creation through IS/IT such as databases are required for the management (for example quality control, availability of parts, etc.) and validating ideas (for example fit to customer demands), but the production of creative ideas are based on experiencing *at the place* (*Ort*) where the phenomenon, action, objective, incidence, etc. happens or happened. The knowledge creation through IS/IT is important to identify the 'place of incidence' (*Ort*) as stated by several interviewees, for example, quality systems are used to identify error rates in different factories and different counties, which allows identifying what and where (place, *Ort*) the mistake or error occurred. Secondly, the knowledge creation '*at the place*' (*Ort*) is one side of the coin. The pattern identified two different spaces of knowledge creation ('*in the thick of action*') and creation of creative idea (*Freiraum*), which is required to produce (a) a valuable or appropriate (*thick of the action*) and (b) original or novel (*Freiraum*) idea. The dynamic of generating a novel idea requires change to emerge. This will be discussed in the next pattern.

## 6.10 Pattern 9: Change in work and thought routines

The last pattern identified from the analysis is the pattern of change in thought and work routines.

### 6.10.1 *Pattern elements*

The creativity routines and practices, which are conducive to innovation as identified in the survey analysis are presented in Table 6-23.

| **Relationship to innovation performance** | | ***r*** | ***p*-value** |
|---|---|---|---|
| 9.1 | (J.3) Creation of new ideas through the combination of expert knowledge from different disciplines | 0.427 | < 0.001 |
| 9.2 | (J.7) We create new ideas by approaching the problem differently | 0.419 | < 0.001 |
| 9.3 | (J.1) We have defined processes to solve problems | 0.370 | < 0.001 |
| 9.4 | (J.4) We create different scenarios to think about the most effective ideas | 0.357 | < 0.001 |
| 9.5 | (J.2) We have specific methods in our organisation to create new ideas | 0.351 | < 0.001 |
| 9.6 | (J.8) In our organisation we create new ideas by speaking out our true opinion | 0.350 | < 0.001 |
| 9.7 | (J.9) We create new solutions through the viewing the problem from different perspectives | 0.313 | < 0.001 |
| 9.8 | (J.10) We have a defined process to think about the implementation of ideas | 0.254 | < 0.002 |

**Table 6-23: Presented variables of 'intellectual bin' of creative routines and practice (PCA)**

The nature of creativity involves novelty and change, therefore standardised and repeating routines are paradoxical to creativity. Therefore, the focus groups pointed out that these practices and routines are too simplified and (9.9) change in work and thought routines are required to produce novel ideas otherwise the same ideas are reproduced. The pattern elements are presented in Table 6-24 and the pattern structure is presented in Figure 6-13, which describes this principle related to the nature of creativity.

| Pattern element | | Description |
|---|---|---|
| 9.9 | Change in work and thought routine | The change in thought processes has been stated as 'change of perspective' ('Perspektivenwechsel'). This can be established by observing and experiencing something new and by listening to different perspectives within conversations. |
| 9.10 | Individuals' characteristics | Individuals' characteristics have been stated such as motivation (pattern 1, page 199) and openness to change (pattern 4, page 216). Furthermore, two mutually exclusive characteristics have been stated, namely, the ability to be creative, while others have argued that everybody is creative within the interviews. In addition, experience as been pointed out as a characteristics of individuals (Table 6-22, page 240). |
| 9.11 | Social and organisational environment | The social and organisational environment that facilitates and prevents change has been discussed throughout this chapter. The space that facilitates openness to change is *Freiraum*. |

**Table 6-24: List of pattern elements of change in work and thought routines (focus groups and interviews)**

### 6.10.2 *Pattern structure*

The pattern structure in this section differs as it represents the principle of change (change in perspective and action) required for creativity rather than a dynamic that facilitates it. This is presented in Figure 6-13.

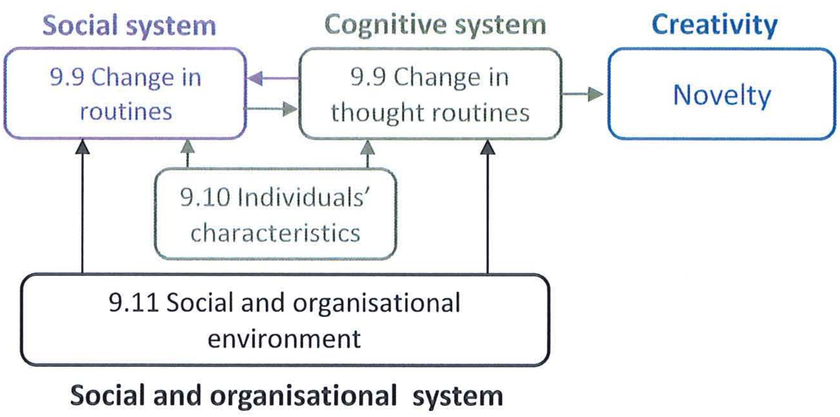



**Figure 6-13: The pattern structure of change in thought and work routines**

This principle of creativity was stated by the focus group as following:

"I believe that the creative process is a **complex** subject, which is here **greatly simplified**. I have the opinion that you need a tool kit of methods within the creative process, which need to **mutate each time**. So, creativity-methods can support creativity in such fashion that **new topics originate**, which cannot be found in a classical process of **someone who thinks in the same routines**. Otherwise you will get the **same collection of ideas**." (Director of Engineering - Focus Group 1)

This indicates that (9.9) change in thought routines is essential in the production of novelty. Similarly, the second focus group contrasted the routines and practices of creativity and stated that,

Person A: "There are in every occupational group some individuals, which may do a good job or might just **do their normal routine**. This also exists in the development department. **Someone who does a good job** does not make him/her a very **creative person**."

Person B: "This means that it is like a sensor. This is a question of the **environment** ... and of course of the **ability** which someone has." (Focus Group 2)

This implies that an individual, who is capable of generating creative ideas, acts outside the normal work routine and creates a change in perspective.

This action and knowledge creation is established through (9.10) individual abilities and characteristics such as intrinsic motivation (pattern 1, page 199) innovation willingness (pattern 4, page 216) and experience (pattern 8, page 237). The (9.11) social and organisational environment that allows space of self-determinacy (*Freiraum* - pattern 3, 4, 5, 6, 7 page 210 to 236) facilitates the exploration and observation of emerging patterns, new phenomenon and trend that lead to a novel idea. This enables the change in perspective towards novelty.

### 6.10.3 *Conclusion to pattern 9: Change in work and thought routines*

This pattern identified the necessity of change in action and thought to produce novelty. Changes in action and thought routines go hand-in-hand as "knowing is doing and doing is knowing" (see autopoiesis and cognition on page 82). Therefore, acting outside the routine and creating knowledge by observing emerging patterns or a new phenomenon, at best at the place (*Ort*) of the phenomenon (*thick of action*) allows new ideas to emerge (come into being).

Each of the nine patterns identified dynamics that are related to knowledge creation and creativity. These dynamics produce the momentary events within individuals' interactions that allow creativity to emerge. The combination of these patterns builds a pattern language (web of pattern) that provides insights about the complexity of how local context within individuals' interaction facilitates creativity.

## 6.11 A pattern language of creativity (web of patterns)

The pattern analysis revealed nine patterns related to each 'intellectual bin'. The patterns are summarised in Table 6-25.

| **Pattern** | | **Description** |
|---|---|---|
| 1 | Individual knowledge creation | Individual knowledge creation incorporates the dynamic of information internalisation and knowledge processing. This knowledge creation can be prevented by information overload and can be facilitated through intrinsic motivation. Engagement in the task needs a space in which individuals can concentrate and focus on the task to observe and process relevant information (*Freiraum*) |
| 2 | Co-creation | This pattern includes the dynamics such as self-organisation, blind dates and human connection between individuals, which establish dialogue that lead to mutual inspiration and co-creation. The co-creation requires unifying different interests, motives and objectives into a new creative approach (idea or solution) and not resulting in conflict (opinion-driven) or compromise. This requires dialogue of freely expressing interests, problems, several points of views and opening up to new and unusual ideas and change (*Freiraum* in conversations). |
| 3 | Vision, strategy and leadership | The dynamic of vision, strategy and leadership can facilitate *Freiraum* and provides challenge and direction. This allows combining the strategic and operational perspective into a strategic roadmap and development of ideas into innovation. |
| 4 | Innovation willingness and reaction to mistakes | The creation of new ideas is dependent on the individual innovation willingness and developing them into innovation requires collective innovation willingness. This requires positive reaction to mistakes, which in turn can increase or decrease (punishment) innovation willingness throughout the organisation. |
| 5 | Ambience and social support | Ambience and social support can produce a momentary space of problem solving and idea creation (*Freiraum*) in which individuals can informally exchange ideas and opinion. |
| 6 | Regulatory and social influence | Organisational design such as structure and processes can result in the prevention of the production of *Freiraum* as it results in time pressure and work routines that do not allow a free space of thinking, creativity and collective problem solving. Furthermore the shred comprehension of work (e.g. thinking) can prevent or facilitate *Freiraum*. |

**Table 6-25: Short description of the nine patterns of creativity**

| Pattern | | Description |
|---|---|---|
| 7 | Communication behaviour | Communication behaviour within momentary events has two mutually exclusive dynamics (exploitation and exploration). Tight structured process of interactions (e.g. formal meetings) is required to 'match actions', but can result in information overload (too many meetings and emails). This communication behaviour is required for exploitation, while exploration requires a communication behaviour that establishes new communication channels (redundancy) and allows the exploration of new opportunities and creation of new ideas and solutions. This paradox of communication behaviour can be overcome through the dynamic and self-organised production of *Freiraum* and organised and structured communication channels (*thick in the action*). |
| 8 | Spaces of knowledge creation and change | The pattern of spaces of knowledge creation identified the importance of knowledge creation (experiencing) at the place (*Ort*) and exchanging experience within dialogue. Furthermore, the two spaces of knowledge creation (*thick of it*) and idea creation (*Freiraum*) allow exploitation and exploration. |
| 9 | Change in thought and work routine | The main finding in this pattern is the principle that creativity requires change in action and thought (change of perspective), which can be triggered by high level redundancy (*Freiraum*) within the self-reproducing cycle (routine) and explore a phenomenon. |

**Continuing Table 6-25: Short description of the nine patterns of creativity**

These nine patterns in Table 6-25 interrelate and build a pattern language (web of pattern). This web of pattern is presented in Figure 6-14 (next page).

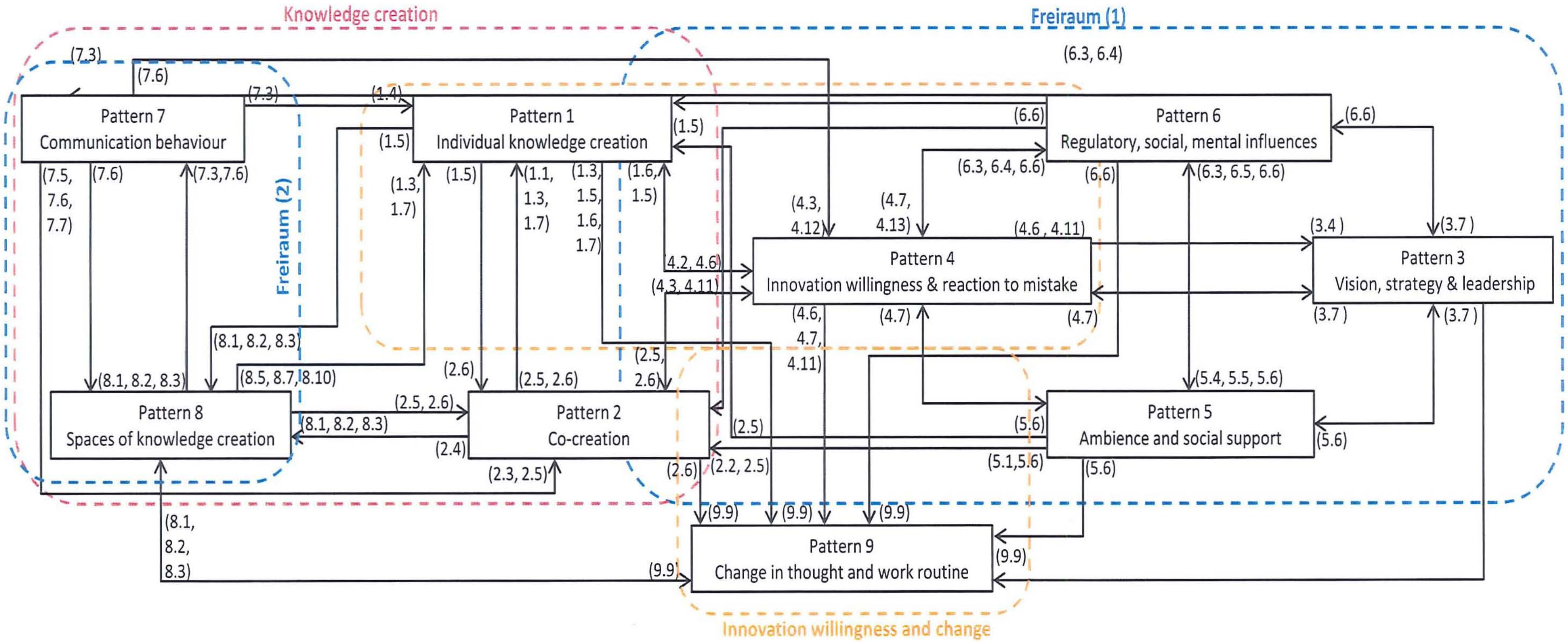



**Figure 6-14: A pattern language of creativity within the organisation, Daimler AG (web of interrelating patterns)**

Figure 6-14 shows the interrelation of the nine patterns. The interrelations are illustrated by arrows. At each end of the arrow the pattern elements are illustrated, which link the patterns. These interrelations build three main rules (or dynamics) of creativity, namely, (1) Knowledge creation, (2) Innovation willingness and change and (3) Freiraum. The patterns can be combined differently as long as the language (web) satisfies these rules.

### 6.11.1 *Knowledge creation*

The first rule in the pattern language is the knowledge creation dynamic. The knowledge creation consists of the individual knowledge creation (pattern 1), co-creation (collective knowledge creation - pattern 2), communication behaviour (pattern 7) and spaces of knowledge creation (pattern 8). The coupling of individual knowledge creation (pattern 1) and collective knowledge creation (pattern 2) give details about the dynamics of new knowledge creation within conversations. For example, knowledge is shared and provided in self-organised social spaces and within conversations (pattern 2). This shared and provided knowledge is internalised and processed depending on the cognitive framework of each individual and when individuals are engaged in the task (motivated) of the conversation (pattern 1).

The coupling of individual knowledge creation (pattern 1) and spaces of knowledge creation (pattern 8) results in the dynamic of knowledge creation within the virtual space (IS/IT), social spaces (face-to-face conversations) and/or physical space (*Ort*). Individuals observe, experience and process information, momentary events and phenomena in conversations, through IS/IT and/or at the place, but information overload and no motivation will prevent the essential engagement in the task ('problem pregnancy') and therefore, prevent creativity. Furthermore this dynamic can be exemplified as the following: IT-systems can be used to get an overview of, for example, market demands or quality problem quota. This cannot be observed through the human senses as a human cannot collect information at several places at the same time (statistical analysis). This statistical analysis allows identifying the 'place of most potential' (*Ort*), for example, where the problem occurred. In the *thick of the phenomenon*, an individual can experience, for example, emerging patterns of social change, state of the art technologies (Zeitgeist) or simply the problem (pattern

8). This allows embodying new knowledge, inspiration and 'problem pregnancy' (pattern 1).

Coupling communication behaviour (pattern 7) with either individual knowledge creation (pattern 1) or collective knowledge creation (pattern 2) identifies the influence of the shared behaviour on knowledge creation. For example, shared and repeating behaviour of formal meetings leads to information overload (pattern 7) and reduction of engagement in the essential task (pattern 1) and dialogue (pattern 2). This prevents creativity to emerge.

These dynamics between the several patterns build the rules of knowledge creation towards creativity within Daimler AG. For the creation of novelty a further dynamic is required, namely, the innovation willingness and change.

### 6.11.2 *Innovation willingness and change*

The second dynamics that produce the rule of innovation willingness and change are the coupling of dynamics of innovation willingness and reaction to mistakes (pattern 4) and change of thought and work routines (pattern 9).

The coupling of innovation willingness (sub-pattern 4-1) with the change in thought and work routines (pattern 9) identified the willingness of an individual to produce a different action outside the normal work routine and produce a difference in thought, which can lead to a novel approach, idea or concept. This dynamic reveals that a change in perspective (pattern 9) that can lead to a creative cognition is dependent on the innovation willingness (sub-pattern 4-1). Doing something new interlinks with uncertainty and making mistakes. Therefore, punishment can decrease the innovation willingness as it is stored in memory of the individuals (sub-pattern 4-2) and prevents change of action and thought in subsequent momentary events and therefore kills creativity (pattern 9).

Similar, coupling the change of thought and work routines (pattern 9) with the collective innovation willingness (sub-pattern 4-2) identifies that when somebody produced a novel concept, the collective requires innovation willingness (sub-pattern 4-2) and needs to change their actions (pattern 9) to develop and implement the new concept or invention. For example, a new production method requires the change and adoption of the assembly line or an implementation of an information system requires the user to change their routine of analysing data.

This second rule of innovation willingness and change includes the dynamics such as innovation willingness is the prerequisite for change in actions and thoughts, which produce novel ideas (observing and experimenting within *Freiraum*) and develop these novel concepts into innovation (change of action and adaption of new routine). Providing spaces of support and self-determination (*Freiraum*) allows the change of action and thought to emerge. This is the next rule (dynamics) within the pattern language.

### 6.11.3 *Freiraum and creation of novelty*

The dynamics of the production of *Freiraum* (free space) has been identified and discussed throughout this chapter. The coupling of the vision, strategy and leadership (pattern 3), innovation willingness (pattern 4), ambience and social support (pattern 5), regulatory, social and cognitive influence on time space (pattern 6), communication behaviour (pattern 7) and spaces of knowledge creation (pattern 8).

The space in which individuals can self-determine their actions, support each other and allow each other to be themselves within individuals' interactions facilitates speaking out unusual ideas and opinions freely and accepting others points of view is produced by the cognitive system (mental space), social system (social space) and organisational system (physical, virtual and regulatory space). This *Freiraum* is produced by the different pattern elements such as empowerment and appreciation by leaders (pattern 3, 4), allowing individuals high level of freedom (pattern 4, 5), stress free moments with no distraction (pattern 4), open communication (pattern 4), social support (pattern 5), ambience (pattern 5), no time pressure (pattern 6), processes and structures allow workload balance (pattern 6), working outside the routine (within *Freiraum*) in a creative mode is accepted as working (pattern 6) and trust (pattern 7). This Freiraum allows dialogue (own opinion and view by being themselves – pattern 2), able change perspective as one can experience and explore something new outside the routine (in *Freiraum*) (pattern 6, 9) and self-determination (intrinsic motivation) and openness to change (pattern 4). This *Freiraum* allows the creation of a novel idea and change (pattern 8, 9). Experience is required to be able to produce a valuable, appropriate or useful idea and/or expertise can validate and develop the novel idea into a creative idea (novel and valuable). This combination, development and construction require *Freiraum* as it enables dialogue. These dynamics of the rule of *Freiraum* produce momentary events in which individuals and groups can generate creative ideas and solutions.

Furthermore, the principles of *Freiraum* have been described in a specific virtual space by interviewees. These virtual free spaces (virtual *Freiraum*) are so called, 'online innovation jams' and 'online innovation communities', in which employees can freely express their ideas, with open discussion forums. Daimler AG developed such an 'online innovation community', which has been stated as one of the biggest idea databases in the world. This community provided 'idea ownership', basic fields to describe the idea (for example description, target customer, etc.), idea rating and discussion forum. The community is open and transparent and no monetary reward is provided. The openness provides social reward through idea ownership and express of ideas is driven by intrinsic motivation (no competition for the best idea), which allows free combination and discussion of ideas. Similar to the *Freiraum* in physical spaces, the virtual *Freiraum* requires interactions based on respect to be produced.

### 6.11.4 *Conclusion to a pattern language of creativity*

The pattern language of creativity revealed three main rules that need to be satisfied for creativity to emerge within individuals' interactions embedded in the large organisational context. These dynamics of the three rules of the pattern language are illustrated in a 'soft' system model, which will be discussed and presented in the next section.

## 6.12 The 'soft' system model of creativity

The 'soft' system model represents and unifies the three rules and their dynamics of the pattern language of creativity. This model is designed according to the Occam's razor, which includes designing the model as simple as possible, but not simpler. This model represents great complexity (several dynamics within the pattern language) in a straightforward and uncomplicated way.

### 6.12.1 *Coupling the knowledge creation, innovation willingness and Freiraum*

The rules of (1) knowledge creation, (2) innovation willingness and change and (3) *Freiraum* build a model that represents the complexity of producing (a) value and appropriate knowledge and (b) novel ideas and change into a creative idea (novel and valuable). (1) Knowledge creation towards creativity is the creation of experience within actions and interactions. This experience is necessary for the creation of appropriate and valuable ideas (for example experience the system of an organisation to know what and how to create and implement change). The rule of (2) Innovation willingness and change is the dynamic that enables, firstly, motivation to change action and thoughts towards novel ideas (novelty and change) and secondly to change action and thought towards developing the idea into a creative product (novelty and value). (3) Freiraum is the 'room for manoeuvre' (redundancy) within a system that enables exploration, new combinations and change (creation of novelty). This novelty is promising to be creative in that sense that it is based on experience (valuable embodied knowledge created in the *thick of the action* related to the task/phenomenon). Each of the rules is only one part of the dynamic and emergent phenomenon of creativity within the local context of individuals' interactions and momentary events. The coupling of the three rules of (1) knowledge creation, (2) innovation willingness and change and (3) *Freiraum* provide a more coherent picture of the local context related to creativity. The coupling of the three rules and their inherent dynamics produce a model of two spaces, namely, *thick of the action* (space of valuable knowledge creation) and *Freiraum* (space of change and creation of novelty), which are connected by the innovation willingness (intrinsic motivation, openness to change and risk-taking) as presented in Figure 6-15.

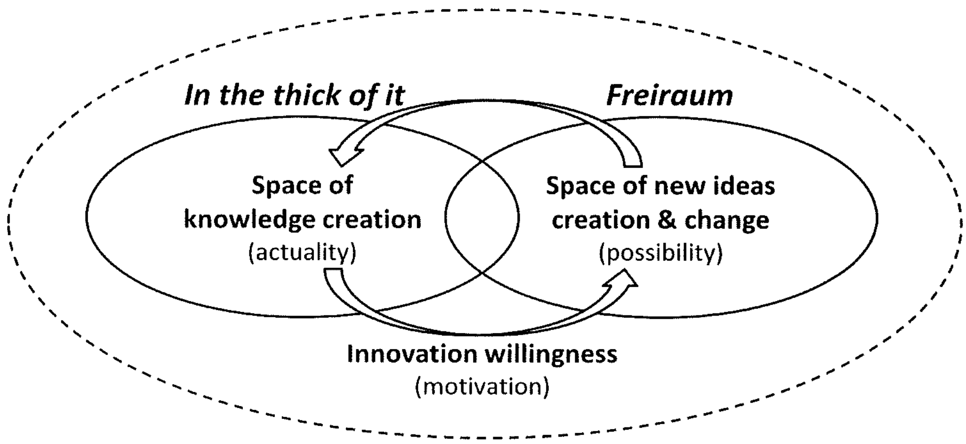



**Figure 6-15: Simplified representation of the 'soft' system model of the local context that enables creativity within individuals' interactions**

The model in Figure 6-15 shows the two spaces of (a) knowledge creation within the normal work routine (*thick of the action*) and (b) change in perspective and idea creation (*Freiraum*). In the (a) space of knowledge creation (*thick of the action*) individuals and collectives build specific experience and expertise. Within this space, an organisation builds expert clusters and centres and project teams that collectively produce and execute, for example, a concept into a module of the automobile (for example new hybrid engine). This requires working in a routine and structured way and enables gathering of experience. For example, a developer acquires expertise about technology and engineering, while an individual in marketing acquires customer knowledge (at best *at the place*). These experts from different departments interact in regular meetings, which are used to match their actions ('abstimmen'). This is organised by structures, processes and regular meetings ('Regel-kommunikation') within the organisation, which makes the organisation efficient and allows it to exploit innovation (exploitation). This is based on individual knowledge creation (pattern 1), co-creation (pattern 2), a specific type of communication behaviour (pattern 7), which builds the space of *thick of actions*, in which individuals create knowledge and experience (pattern 8).

The space of (b) change and new idea creation (*Freiraum*) is the space in which individuals can self-determine their action, driven by their intrinsic motivation and can explore and observe new emerging patterns (for example opportunities for new mobility concepts). The intrinsic motivation is crucial as otherwise individuals are not using the produced *Freiraum* for the exploration and creation of novel ideas.

Individuals are using their expertise (ideally in interdisciplinary teams with mutual motivation) to observe and explore new possibilities and create new ideas (exploration). As *Freiraum* is a space in which dialogues can occur by mutual respect, free expression of opinions, accepting different views and no opinionated leaders. These teams can create multiple perspectives (as discussed in pattern 2, page 204) and use their experience and new embodied knowledge (experience at the place) to create a change in perspective (as examined in pattern 9, page 243) and produce promising novel ideas.

The differences of the two spaces have been described by an innovation manager as two different phases of conditioning the mind. The organisational context such as leaders and colleagues condition the mind of individuals (and vice versa) in such a way that individuals engage with the topics of "where we are today" (sphere of actuality). This is the (a) space of *thick in the action* as it requires concentrating on actions to perform a certain task, execute an action plan or implement a concept. This space limits the 'field of view' ('Sichtfeld'), similar to the focus of either the 'joystick or steering-wheel' (as described in pattern 2, page 204), but produces experience and expertise. In contrast, the second space (*Freiraum*) allows opening up the 'field of view' and exploring besides the 'routine way' ('links und rechts vom Weg schauen'). This requires, firstly, taking the freedom to explore. Secondly, it requires having the (b) space of freedom (mental, social, regulatory *Freiraum*), in which individuals are able to self-determine their actions, focus on new opportunities and engaging with possibilities (sphere of possibility). The engaging with the possibility requires knowing, because the "intuition is not emerging by random chance." This was exemplified by the discovery of America as they knew something must be there. Therefore, knowing where (place, *Ort*) to search for emerging patterns that leads to a discovery or invention relevant to the task is essential. This knowing (intuition from experience created in the *thick of the action*) or direction (organisational vision) allows conditioning the mind towards the possible.

Furthermore, within both spaces motivated individuals are vital. The rule of (2) innovation willingness and change connects the two spaces. The innovation willingness is required to produce novelty (from *thick in the action* to *Freiraum*). One needs to be motivated to produce novelty. Without motivation individuals do not use the produced *Freiraum* to explore and create new ideas. Therefore, the move from *thick in the action* to *Freiraum* is based on individuals' innovation willingness to explore and create novelty. Within *Freiraum* the motivation is intrinsically determined, because *Freiraum*, by its nature, is a space in which individuals are empowered and can self-determine their actions. Secondly, innovation willingness including risk-taking is essential for validating, prototyping, developing and implementing the novelty (from *Freiraum* back into *thick of the action*). The several individuals involved within the project need to be open to the change and need to take risks to bring the idea back into the routine, the space of *thick of the action*. Therefore, the innovation willingness of the collective is the enabler to move from *Freiraum* back into the *thick of the action* (new routines). Without the openness to change risk-taking individuals will not take new actions relevant to develop the novelty or simply go back to the existing routines (change was only momentarily). This indicates that the creative process is a spiral between the two spaces of (a) *thick of the action* and (b) *Freiraum*.

### 6.12.2 *Conclusion to 'soft' system model of creativity*

The coupling of the three rules and their inherent dynamics allowed constructing the model of creativity within individuals' interactions within Daimler AG. This model illustrates the need of an organisation to dynamically produce different spaces, which allow the creation of valuable knowledge (exploitation) and the exploration and creation of novel ideas (exploration). Furthermore, redundancy within the system (*Freiraum*) allows individuals' and teams to explore and create new knowledge within the organisation (endogenous) and outside the organisation (exogenous) by making the decision where to go (*Ort*) and with whom to interact (employees, customer, supplier, competitor, universities, etc.). The interactions between the two spaces produce a spiral of creativity.

## 6.13 Interpretation of 'soft' system model: Spiral of creativity

The interpretation of the 'soft' system model and findings from the interviewee data revealed a process or spiral in which creativity emerges. The spiral of creativity incorporates several momentary events (flow or fluent process) within individuals' interactions. These several events (temporal and spatial context) match to the stages of the spiral between the *thick of the action* (actuality) and *Freiraum* (possibility) as presented in Figure 6-16.

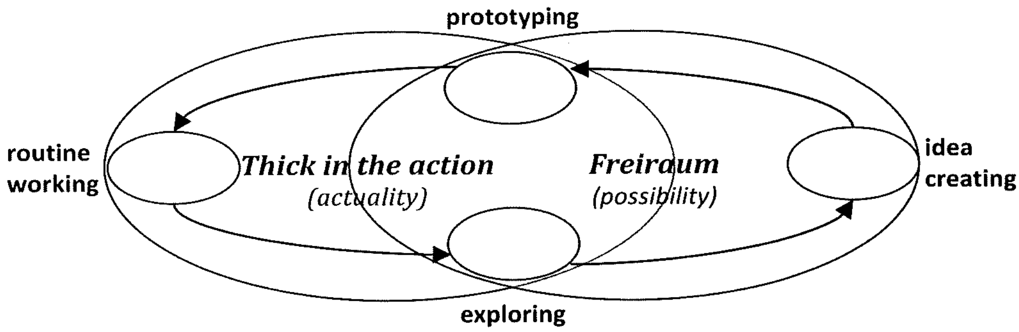



**Figure 6-16: Simplified spiral of events within thick of the action and Freiraum**

Figure 6-16 shows the interpretation of the model in relation to the chain of events (fluent process) stated and described by several interviewees. Four main momentary events (spaces) have been identified, which will be discussed in detail in this section. These four spaces in which creativity emerges are a 'frozen' representation of the fluid process ('process view'). The fluid world ('process view') is 'frozen' into entities to make sense of it. This sense-making has the purpose to provide 'actionable knowledge'. Therefore, the chain of momentary events of the fluid process ('process view') is not linear step process, but rather a representation of the several events (temporal and spatial context) involved in the creative spiral or process. The first space identified within the spiral of creativity is the space of routine working.

### 6.13.1 *In the thick of the action*

The space of *thick in the action* is the temporal and spatial context of routine work. In this space individuals reproduce and repeat actions and create existing knowledge, which builds experts and expertise centres within an organisation. In this space employees are conditioned to execute and perform current task and topics (actuality). This space is produced by structured processes and routine work in which individuals create experience and knowledge by observing and repeating action (reproduction).

Several interviewees have emphasised the importance of expertise and experience within the creative process. This has been stated as "an experienced engineer simply knew where to look and what might have caused the problem." This experience has been stated as important for knowing where the problem might be, essential in interpreting information (for example statistical data) and essential in conversations of problem identification and definition. This knowing (experience) is important in the identification and definition of the problem or opportunity. Knowing where and what to observe and examine is the beginning of the creative process. The organisation spends a great effort to gather data such as product quality, customer requirements, and new technologies through, for example, customer research centres, quality centres and technology centres to identify potential key problems and opportunities. This allows the several experts to know where to start observing and examining.

On the other hand problems of experience and expertise have been identified by the interviewees. One of the key problems is the conflict of interests within routine work. Each employee has its own management objective provided by each department. For example, an engineer has the objective to develop a light-weight automobile for fuel efficiency, while sales and marketing needs to bring in many customer features. These different management objectives can lead to goal conflicts. While being in the routine (bounded space), individuals perform according to their routines and objectives. Within project teams these different routines and objectives (interests) from different departments can lead to conflict, which can prevent collective creativity and co-creation (Table 6-6, page 209). Therefore, individuals are required to not only become experts in their own field (domain and department), but are required to understand the objectives, interests and points of view of the several experts involved. This includes the complexity of different language different departments (for example engineering: numbers driven and marketing: words driven).

While being in the routine and one's own environment it is difficult to understand others' interests, routine, objective and language. This has been stated as the problem of experience and expert knowledge. This is the problem of fixation, which can prevent the creation of new ideas. Interviewees stated that "experts produce novel ideas and approaches to a certain point and then reproduce the same ideas" (see also pattern 9, page 243). Through the reproduction of action and interaction within the same environment individuals reproduce their actions and thoughts. Therefore, several individuals have emphasised that individuals are required to understand different fields (for example engineering, sales and marketing, quality), step out of the routine (physically, social and mental) by visiting other departments, organisations and fairs, observing problems at the place (for example assembly line, other countries) and search for potential opportunities at the place of most potential (as discussed in pattern 8, page 237). The stepping out of the routine is the next step in the creative process, which allows observing and experiencing 'something new' and change perspective. This observing and experiencing requires innovation willingness (motivation) and *Freiraum*, which produces the space of exploration.

### 6.13.2 *Space of exploring 'at the place' (vor Ort)*

The space of exploration incorporates observing, experiencing and exploring outside the routine (*Freiraum*) and at the place of most potential (*in the thick of the action*). It is the space that allows the change in focus from actuality to possibility. The space enables individuals to explore, for example, new emerging patterns (for example new social trends). By stepping out of the normal routine and environment individuals' can experience and explore new phenomena and create a change in perspective and overcoming fixation. This space has been described as engaging with the essential tasks in two to three day workshops (*Freiraum*), being or becoming a cosmopolitan ('Weltbürger'), process of conditioning the mind ('problem pregnant') of individuals towards creative ideas and solutions and to change the perspective of individuals within conversations.

The process of stepping outside the routine and observing and exploring a phenomenon, opportunity, problem has been described by an interviewee as being or becoming a cosmopolitan ('Weltbürger'). He described that this is like driving every day to work. At the beginning an individual tries different routines to find out which is the fastest, until he/she thinks this is the optimum way and then drives the exact same way over and over again. Similarly, engineers have tried different approaches until they think they have produced the best possible solution. Stepping outside these thought routines are very difficult within the same work routines. Therefore, Mercedes-Benz needs cosmopolitans ('Weltbürger'), who understand different context in different countries and cultures. This has been exemplified as one need to observe the Monsoon in Thailand and the problem it can cause (for example water damage) or experience the cold in Canada in combination with the long traffics, which results in certain customer demands. Similarly, different behaviour and requirements in China have been stated by other interviewees, which led to the development of the Mercedes-Benz Long Wheelbase E-Class, because most Chinese who own an E-Class do not drive themselves and therefore want more space in the backseats. Further examples are the knowledge creation at design fairs, which led to inspirations for a new design, exchanging of ideas with similar departments from other companies led to new management initiatives, benchmark visits at factories of competitors and observation of extreme cases (for example rocket technologies) led to new technological inventions. These examples describe the principle of the space of exploration: observing, experiencing and exploring new opportunities and problems at the place of incidence or most potential (*in the thick of it*) outside the normal routine (*Freiraum*), which leads to a change in perspective, overcoming fixation and 'problem pregnancy'.

In the production, this process was described as observing the error where it occurred together with different departments (for example development). This experience allowed the developer to have a better understanding of the problem and therefore enabled him/her to think about the solution in more depth. This has been stated as important for creating a solution and resulted in better solutions. The principle of observing at the place (assembly line) has been institutionalised in the management program called 'shop floor management'.

Furthermore, the space of experiencing has been described by an innovation manager as the start of the creative process through conditioning the mind of individuals towards a 'problem pregnancy' or 'idea pregnancy'. Topics, problems and defined opportunities with high potential ('state-of-the-art') are presented to individuals to conditioning their mind with the task, problem or opportunity. The identification of high potential tasks and opportunities ('state of the art') is essential to produce inventions, because otherwise it can result in re-invention rather than invention. As stated above, the identification of the 'state-of-the-art' or high potential opportunities requires expertise and experience (first space). This can be executed every week for half a day to slowly and stepwise conditioning the mind ('idea pregnancy'). The essential characteristic of this conditioning of the mind is that individuals engage in tasks of opportunities (possibility) rather than problems in the daily routine work ('Alltägliches Geschäft'). Employees are often too focused on the daily problems in the routine work and therefore are conditioned with actual problems (actuality) rather than with potential opportunities (possibility). Therefore, employees are required to produce *Freiraum* for a certain time. The *Freiraum* allows the individuals to engage with the essential task of opportunities, while conditioning the mind by observing and experiencing (*in the thick*) related phenomenon or patterns.

This observing and experiencing *in the thick* of it has been described as an essential step in the idea creation workshop at Daimler AG. Interdisciplinary teams are taken out of the routines (workshop) and engage in a specific high potential task (strategic search field). These interdisciplinary teams have been taken to places of high potential (*Ort*) relevant to the task. Examples of this step in the creative process are the parking spaces of shopping malls to generate customer experience to create the next shopping car and parking spaces at the Autobahn to observe behaviours and talk to salesman to create the next business car. This conditioning of the mind by experiencing at the place triggers a change in perspective and led to the creation of novel ideas. This change in perspective has been exemplified by an engineer as following: "When you drive back home, try to observe how many red Porsches are driving on the street and suddenly you recognise how many there are, which you have not recognised before." This change in perspective is an essential step towards the creation of a novel idea. This step requires, firstly, the *thick of the action* to explore relevant phenomena, which enables individuals to change perspective and get idea pregnant (motivated). Secondly, the necessary *Freiraum* is required, which allows individuals to engage and explore intrinsic motivated tasks. This chain of momentary events leads the individuals into the next step, the creation of novel ideas.

### 6.13.3 *Freiraum (creation of novel ideas)*

The space of *Freiraum* allows changing the focus completely from actuality to the possible. This space enables individuals to open up to change, discuss and process several aspects of gathered experience, exchange different perspectives and opinion and creating novel ideas. Interviewees have stated, that "new ideas are created by experts within a specific field, because they are the experts and engaged with a specific task/problem or by thinking about, where do I [the company] want to go in future." Both idea creation processes requires the focus on possible solutions or possible opportunities and the necessary *Freiraum* to do so. The thinking of the possible future allows individuals to engage with possibility rather than actual problems and tasks. This thinking about the possible is the visioning and imagining from a specific perspective (conditioned mind). *Freiraum* enables individuals to imagine possibilities, opening up to change and interpreting certain tasks from their own self-determinant point of view, which is openly and freely discussed. This collective engagement in the possible allows visioning and imagining new and novel ideas and solutions.

This space in relation to idea creation has been described by the interviewees as creating spontaneous ideas in the shower or on the toilet, while being 'idea pregnant' (intrinsically motivated and deeply engaged in the task) (also pattern 1, page 199), idea creation within open discussions and dialogue away from the meeting atmosphere and work environment (idea workshops), creating ideas from the experience of a specific artefact and adopting ideas from a different context (extreme contexts) into the specific context of the automobile.

The creation of spontaneous ideas in spaces of *Freiraum* (for example shower) is based on the 'idea pregnancy' of an individual. Interviewees emphasised that a shower alone does not make an individual come up with an idea. Therefore, individuals need to be deeply engaged with the task/problem and being in the thick of it beforehand to be able to process the experienced into an idea during such moments of *Freiraum*. This is only possible, if individuals are not distracted by daily work problems (actuality), but rather can focus on the possible (possibility), which requires the necessary *Freiraum*. Similarly, the idea creation from experiencing existing artefact or technology from a different context requires a change from actual (existing artefacts and technology) to the possible (new applications or combinations of existing technologies). By interacting with the existing artefact one gets inspired (actuality) and when changing to focus on possible applications (possibility), an individual is able to imagine and create an idea (for example by abstracting, combining and analogy, see in Appendix A on page 357) based on the experience gathered. The application process of a certain technology into a specific context has been exemplified as observed rocket technologies (experience) has been used to create an idea created for a safety feature in the automobile. Similarly, examining different aspects of the future urban life, social trends and existing initiatives and focus and imagining future environments led to creation of ideas of new mobility concepts, which resulted in the concept: Car2Go. These examples illustrate the process of conditioning the mind (space of exploration) and following up with idea creation processes, by focus on possibilities (space of idea creation), which produces novel ideas.

Furthermore, the creative dialogue (co-creation) has been discussed and described by several individuals. This creative dialogue within an idea workshop is established within a specific open room (physical space), which takes the individuals out of the work atmosphere. Within this workshop (networked co-creation) individuals are guided through the dialogue of creating ideas. The dialogue conversations have a certain context such as everybody can freely express their view, hierarchy does not apply (everybody has the same voice) and relaxed atmosphere. This context provides the *Freiraum* to create, express and discuss novel and unusual ideas.

Before an idea workshop (creative dialogue) the individuals involved are getting information about the topic or task. This stimulates or conditions (towards the possible) the individuals before the discussion and individuals are able to start the conversation at a similar information level. The process starts by providing relevant information and discussing an open and general topic (for example a comfortable feeling while driving). The conversation becomes more specific through the interpretation of the topic (for example comfort includes comfortable seats), which allows the group to focus and create specific ideas (for example massage seat). This has been stated that the idea creation process begins with a kind of chaotic thinking and is followed by structured execution (channelling) including describing and prioritising ideas.

In these dialogues, it is important to review different and extreme perspectives (interdisciplinary teams and specific individuals). This was exemplified by several individuals with specific abilities. For example, specific individuals that can support the creative process could be someone who knows much about numbers and can tell how expensive this might be, someone who is very creative and can come up with a lot of ideas and someone who constrains ('down to earth') and says have you thought about this and that or an outsider who can freely ask basic questions, which experts do not ask, because they do not want to be perceived as incompetent. This helps the several individuals to perceive the task or problem differently. These conversations require that everybody is engaged in the task with a high level of freedom of thought, expression and action (*Freiraum*). Furthermore, a 'variable of disturbance' (for example mutual exclusive problematic or extreme case) can stimulate and inspire the creative process. In these discussions several group methods are used to produce ideas. An interviewee described the process of creating ideas. In this process the first created ideas are mostly the ideas that everybody know already. Therefore, a second idea creation process is executed after half an hour break in which the several ideas created are questioned and taken apart. This second process allows the individuals to step into the creative process and produce novel ideas. It was emphasised that these creative dialogues are based on relaxed atmosphere, trust (for example no idea stealing) and open questioning and critically discussing perspectives and ideas (context of *Freiraum*). Each idea is discussed and prioritised by the group. The best ideas are then followed up by the individuals supported by the innovation management. This led to the next space.

Additionally, interviewees have stated that the focus on possibilities can be triggered by executing open sessions of "Make a wish" ('Wünsch Dir was'). By opening up this sphere of possibilities (mental *Freiraum*), individuals start thinking and imagining based on their experience of how the product would be even more valuable to them or what feature they would like to have in the next car and this resulted in several good ideas. This sphere of possibilities and space of idea creation has been institutionalised by 'online idea portals' and 'online idea communities' (open innovation). These online idea communities provide a virtual *Freiraum*, in which individuals focus on the possible and can freely express and discuss these possibilities (novel ideas). These created and prioritised ideas need to be followed up, which is the next space in the spiral of creativity.

### 6.13.4 *Space of prototyping (ideas back into the thick of action)*

The space of prototyping is the space in which novel ideas are validated, developed and constructed into a feasible and viable concept or prototype. This space represents the momentary events in which individuals change the focus from the possible (*Freiraum*) towards the actual (*thick in the action*) by bringing the idea back into routine (self-reproduction of the system). Bringing a novel idea back into routine is a very critical space in the spiral of creativity, which incorporates three main challenges, namely, (1) matching and developing a novel idea into a novel and valuable (feasible and viable) idea, (2) willingness to develop the idea into a concept and prototype and (3) positive reaction to mistakes. These three main challenges need to be mastered to bring the idea from *Freiraum* back into the *thick of the action.*

Firstly, the novel idea needs to be explored and developed towards its feasibility, viability, value and appropriateness. Interviewees emphasised that often ideas have a large potential, but initial ideas do not inherently have the complexity of the development, implementation and use (for example change in processes, technology readiness). For example, the electronic automobile requires a battery that can be loaded quickly and a network of stations to load batteries. This exemplifies that an initial idea can have large potential, but requires further development and further ideas to make it an invention and innovation. Therefore, the idea development requires matching the idea ('reality check') with the expertise and experience of experts (*thick of the action*). These matching conversations (space of prototyping) are a critical stage of bringing the idea back into the production of the system. The space of prototyping embraces the complexity of matching two different modes (*Freiraum* and *thick in the action*). This complexity has been described as following: On the one hand, the individuals who have created the high potential ideas and promote and push these ideas (*Freiraum*) do not have the detailed knowledge to actually build the concept and prototype and cannot foresee the problem it might cause. Therefore, the idea may not be feasible within the existing system (e.g. social system will reject the concept) or current technology available. On the other hand someone with detailed knowledge of the complexity is not willing or able to free him/herself to open up to the change. The art in the space of prototyping is to bring the different mental cases (perspectives, interests and knowledge) together into a constructive conversation towards developing the idea into a creative idea (novel and valuable). This requires collective innovation willingness (openness to change and risk-taking), commitment and mode of dialogue (*Freiraum*) to produce a creative idea (novel and valuable).

The second challenge to master is the innovation willingness including openness to change, risk-taking and commitment from the different experts and management to develop the initial idea (novelty) into a novel and valuable idea. The innovation willingness was discussed in pattern 2 on page 204. The process to establish collective innovation willingness and commitment has been described as to collect and include individuals ('Abholen und Mitnehmen'). This means to engage proactively with the involved experts and individuals to inform, discuss and develop the idea. Interviewees have emphasised that including individuals in the creation and development of ideas results in the motivation to promote and implement the created ideas as it becomes their idea as well (co-creation and co-ownership).

In these matching discussions of several experts different interests, perspectives and motivations can result in conflict or compromise (as presented in Table 6-5, page 205). The conflict and compromise can have the consequence of killing the idea or transforming the high potential idea into a middle range idea (not really new or with high potential). Therefore, an initial idea needs several further discoveries and sparks to become a novel and valuable (feasible and viable) concept or prototype. This has been emphasised by an innovation director as the following: "The process from initial idea to resulting outcome requires much more creativity than the initial idea creation." Therefore, experts are required to unify their several perspectives and interests, without losing the high novelty and potential of the initial idea. This requires the creation of synergies (ideas that overcome and solve the compromise). This process requires collective creativity and therefore dialogue and *Freiraum*.

The production of *Freiraum* to prototype the idea into an innovative concept or prototype requires resources such as time and budget. Therefore, ideas need to be sold to the management to get a so called 'idea godfather' ('Ideenpate'), who provides the resources and the empowerment to produce the necessary *Freiraum* to develop the ideas. The selling of ideas is in itself complex. Leaders have to trust the employees' abilities and ideas and take the risk to investigate in the idea. Leaders often won't make decisions based on uncertainty, which prevents the commitment to explore and develop a novel idea. An interviewee explained that ideas need to be explored and developed on a small scale with little resources ('auf kleiner Flamme') to identify the value and the feasibility of the novel idea. This initial validation and examination of the value allows tempting management to support the idea and reduces the level of uncertainty. This initial exploration requires a 'basic' *Freiraum*. These projects within the basic *Freiraum* are the so-called 'submarine projects' as they are 'underneath the surface of the management view'. Without this basic *Freiraum* ideas are unlikely to get to the stage of readiness to be presented to management and are unlikely to get commitment and support.

The space of prototyping requires both the necessary space of possibility or *Freiraum* (for example dialogue, empowerment, resources and self-determinants within the project) and the necessary space of actuality or *thick of the action* (for example matching idea to experts experience, using existing technologies to build the prototype of the idea) to develop the novel ideas into a novel and valuable concept or prototype. Without the space of prototyping it is difficult to validate the feasibility, viability and value of novel ideas, because a novel idea (when it is really innovative), by its nature, cannot be predicted beforehand. Therefore, as the ideas are explored and developed more into a concept or prototype (moves towards *thick of the action*) mistakes are more likely to occur. This process from prototyping towards establishing change in the thick of the action requires positive reaction to mistakes, which includes the fast learning and solving of mistakes.

### 6.13.5 *Thick of the action (the beginning of the next cycle)*

Back in the *thick of the action* (space of actuality) the action of individuals consists of building and constructing the novel and valuable prototype or concept and adoption of the change by experts involved in the project. By executing and building the concepts mistakes are highly likely to occur. Therefore, it is essential to react positively to mistakes.

The reactions to mistakes include openly addressing, identifying and defining the problems, producing a solution and bring the solution back into the project. The mistakes in the thick of the action are the beginning of the next spiral of creativity. Making the mistake occurs in bringing the concept into routine work (*thick of the* *action*). This mistake needs to be identified, openly communicated and defined, which requires the necessary *Freiraum* in which individuals have the space to explore the mistake or problem (space of exploration). This problem needs to be solved (space of idea creation) and validated and tested (space of prototyping). Therefore, dealing with mistakes requires the production of the spaces of exploration, idea creation, prototyping and bringing it back into routine work.

Furthermore, the spiral of creativity is a self-reinforcing (self-reproducing cycle) as doing something new leads to creating something new, which leads to doing something new. The spiral has been stated as follows:

> "If you create, develop and implement something new, individuals' generate context specific knowledge and from this knowledge one can create something new again. It is a step process; at, the bottom line, it is a cycle. Every time someone generates something new, someone generates new knowledge. And from this knowledge something new arises." (Innovation Manager - Interview 44)

Therefore, by constantly exploring, creating, prototyping and building something new, new knowledge is created and new ideas can arise, which is a self-reinforcing cycle (self-production). This requires constantly exploring, creating and prototyping something new, which is not possible without the necessary (1) expert knowledge (*thick of the action*), the (2) innovation willingness including openness to change, intrinsic motivation and risk-taking the necessary (3) *Freiraum*. From this point of view, an organisation can drive innovation by a high level of redundancy (Freiraum) within its system as individuals generate and develop new ideas, which leads to new knowledge creation, which ultimately leads to new ideas as long as they are intrinsically motivated and willing to innovate (bringing different interests into synergy) and do not 'rest on their laurels'. Therefore, creativity is its own driver as it self-reproduces new knowledge creation.

### 6.13.6 *Conclusion*

The model identifies that creativity is not only the idea creation within the organisation but rather a cycle between reproductions of action and thought (expertise, experience and 'problem pregnancy') and change in action and thought (intrinsic motivation, openness to change and self-determination). This novelty in turn is brought back into reproduction of action and thought by prototyping through the use of expertise and continuously creating new experience within the uncertain process of developing the new idea. This new experience in the *thick of the action* leads to new identified problems or opportunities, which in turn requires going back to *Freiraum* and creating new ideas. This builds the spiral of many sparks and discoveries that over time produces innovation throughout the organisation.

## 6.14 Conclusion

The findings of the analysis of the focus group and interview data revealed nine pattern of each 'intellectual bin'. Each pattern identifies important dynamics of creativity within the interactions of individuals. The patterns build a pattern language, which revealed three rules and their inherent dynamics of creativity, namely, (1) knowledge creation, (2) innovation willingness and change and (3) Freiraum. These rules with their inherent dynamics build the 'soft' system model of individuals' interactions in which creativity can emerge within the case study organisation, Daimler AG. This model is a spiral between the spaces of *thick in the actions* and *Freiraum* driven by innovation willingness. These spaces inherent in the creative spiral are constrained and enabled by the greater space (organisational context) and produced by the interactions of individuals (context within interactions and momentary events). This spiral identified the complex, dynamic and emergent phenomenon of creativity within momentary events of individuals' interactions. This fluid process or spiral combined (micro level) with 'the organisation' (macro level) builds the autopoietic system of the organisation of knowledge, creativity and innovation.

# Chapter 7 Discussion: The autopoietic system model of the organisation of knowledge, creativity and innovation

*"In everyday life, 'if' is a fiction, in the theatre 'if' is an experiment. In everyday life, 'if' is an evasion, in the theatre 'if' is the truth. When we are persuaded to believe in this truth, then the theatre and life are one. This is a high aim. It sounds like hard work. To play needs much work. But when we experience the work as play, then it is not work any more. A play is a play." Peter Brook* (2008, p. 157 [1968])

***Keywords***

Autopoietic reproduction · Spiral of creativity and individual and group creativity · from creativity to innovation · autopoietic system model ·

## 7.1 Introduction

This chapter integrates the findings into a theoretical framework and discusses the findings in relation to existing theories and studies from academic literature. The chapter is organised in three main parts.

1. The 'hard' system model and the 'soft' system model are incorporated into the autopoietic system model of the organisation of knowledge, creativity and innovation. This allows the discussion of the self-reproduction of the mental space (cognitive system), social space (social system) and physical, virtual and regulatory space (organisational system) in relation to creativity and innovation.

2. The chapter discusses the spiral of creativity and innovation process. This spiral is discussed, firstly in relation to system states of change of the panarchy model. Secondly, the creative spiral is compared to creative processes from academic literature. Thirdly, the implications of the spiral of creativity on individuals and group creativity are discussed. This section ends with the discussion of the innovation process which brings together the several creative groups and integrates the several creative outcomes into a unified innovative product, service, process or business. This requires overcoming and solving contradiction and conflicting objectives and interests creatively.

3. The last part describes the theoretical framework of the autopoietic organisation of knowledge, creativity and innovation. This framework provides a dynamic capability for organisations to exploit and explore innovation, proactively and dynamically produces improvement and breakthrough innovations.

## 7.2 Self-reproduction: Recursive interaction between the 'hard' system model ('the organisation') and 'soft' system model ('organising')

In this section the recursive interaction of the findings of the 'hard' (greater space) and 'soft' system model (local spaces) is discussed. This recursive interaction is the self-reproduction of the organisation as presented in Figure 7-1.

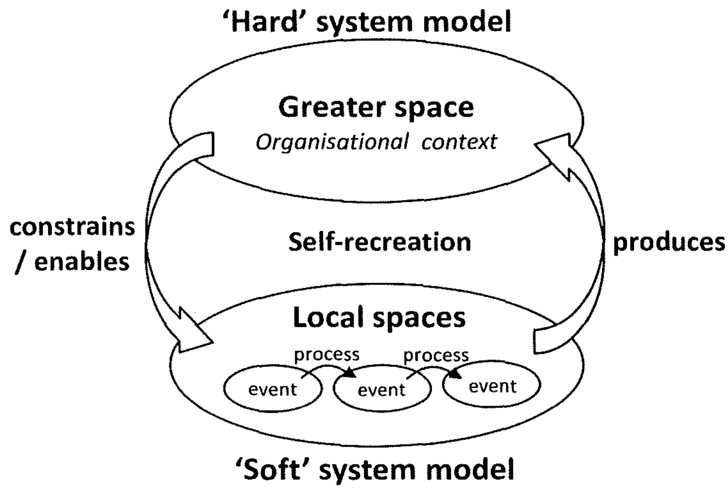



**Figure 7-1: Self-reproduction of the context within an organisation (autopoietic organisation theory)**

The greater space and its organisational context ('hard' system model, chapter 5, page 170) constrain or enable the production of the local spaces within individuals' interactions ('soft' system model in chapter 6, page 197). In turn the local spaces ('organising', flow) within momentary events of individuals' interactions produce the greater space ('the organisation', structure) (Bakken & Hernes, 2006; Hernes, 2004a, pp. 1-40). This section discusses the autopoietic self-reproduction in relation to knowledge, creativity and innovation.

### 7.2.1 *Reproduction and the in the thick of the action (exploitation) and redundancy and Freiraum (exploration)*

An organisation as an autopoietic system reproduces its own mental, social and physical, virtual and regulatory condititions (for example Hernes, 2004a; Magalhães & Sanchez, 2009a; Nonaka & Takeuchi, 1995). A system that reproduces the same conditions (context) establishes standardisation and a highly efficient organisation, but leaves not much 'room' for change. High standardisation and high efficiency enables an organisation to exploit innovation. For the exploration of innovation, an autopoietic system requires a certain degree of redundancy (Bakken, et al., 2009a; Morgan, 2006, p. 105). This redundancy or 'room for manoeuvre' is the space (*Freiraum*) in which individuals are able to explore and create novel ideas and prototype them into creative concepts or prototypes. From an organisational (greater space) point of view, *Freiraum* is the room for innovation and development, the high level degree of redundancy which permits creativity and ultimately innovation to emerge. This redundancy allows individuals and groups to produce change. Therefore, change in a system (e.g. organisation) emerges from small and fast changing systems (individuals and teams) as discussed in section 3.6.3 (page 101).

In contrast, the space in which low level redundancy exists is the space of *in the thick of the action*. From an organisational (greater space) perspective, redundancy is reduced through clear structured processes, defined responsibilities, a high level of shared understanding and a high level of imitation and uniformity within social interactions. The system of low redundancy facilitates a high level of efficiency and builds expert centres through work routine. This allows the exploitation of existing innovation. The two different spaces identified in relation to the systems level of redundancy are illustrated in Figure 7-2

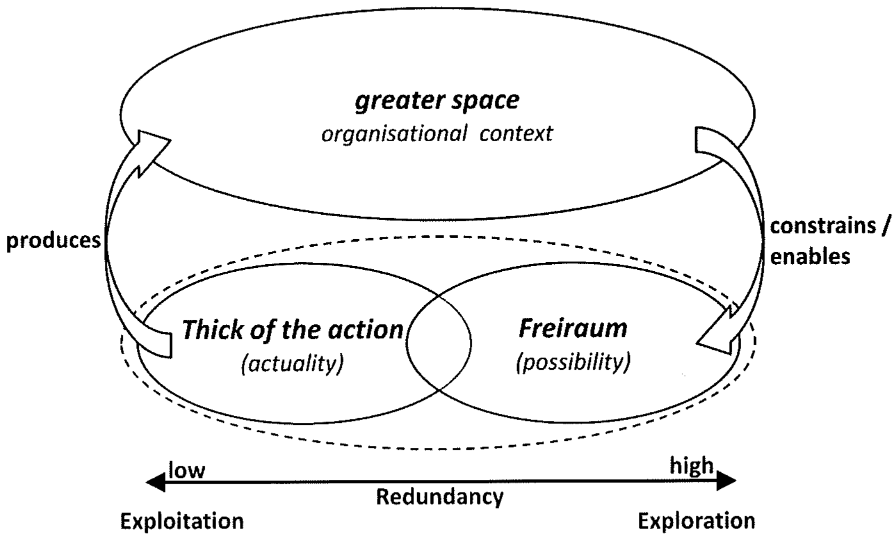



**Figure 7-2: Autopoietic system of high and low redundancy**

The problem with cultivating and designing an organisation that facilitates either low redundancy (exploitation) or high redundancy (exploration) is that the different designs are self-reinforcing. For example, Henri Lefebvre believes that through the growing technocratisation and bureaucratisation of social life (social programming and constrains), spontaneous vitality and creativity has been wrung out of its inhabitants and its spaces (Merrifield, 2000, p. 177). Similarly, Luhmann (2000) argues that through the reduction of uncertainty and complexity in decision making, actions are reproduced. Gilson et al. (2005) argues that teams and ultimately organisations face the dilemma between creativity and standardised work practices. This also includes the innovator's dilemma of exploitation and exploration (for example Christensen, 1997; March, 1991; O'Reilly & Tushman, 2007). Therefore, 'the organisation' requires dynamic mechanisms in which individuals and teams can self-produce different spaces of exploitation (*thick of the action*) and exploration (*Freiraum*). This is constrained or enabled by the greater mental, social, physical, virtual and regulatory spaces, which either prevent or facilitate redundancy within the autopoietic reproduction.

### 7.2.2 *Mental space (cognitive system)*

The first space is the mental space, which incorporates 'thought collectives' and 'thought communities' (Hernes, 2004a, pp. 101-114). Knowledge is reproduced within an organisation through the self-referential cycle of the SECI model as discussed by Nonaka & Takeuchi (1995). The SECI model builds a self-referential cycle, in which mental spaces (thought collective) are reproduced. For example, within routine work, employees create knowledge through observation and interactions with colleagues (socialisation). This knowledge is uttered in group discussions (externalisation) and shared throughout the organisation as information (combination). The observations, utterances and information are internalised by employees (internalisation). Through this thought routine (self-referential knowledge creation), the same knowledge can be reproduced. This is similar to the reproduction of memes within human society (Dawkins, 2006). In a closed system in which different perspectives or opinions are not allowed to be expressed (limited redundancy), no new ideas emerge and the same ideas are reproduced. This reproduction of thinking and acting occurs through the created inherent mental model (inner worldview / theories-in-use) of individuals (for example Senge, 2006, pp. 163-190).

The 'group of factors' in the 'hard' system model (as discussed in chapter 5, page 170) that represents the greater mental space is the information and knowledge management (IKM). The greater mental space consists of the provision and availability of information (B.I and B.II), implicit knowledge management including

(C.I) acquiring and developing experts and (I.III) knowledge creation processes. These factors constrain or enable the interactions and thought processes of individuals of patterns 1, 2 and 8 as presented in Figure 7-3.

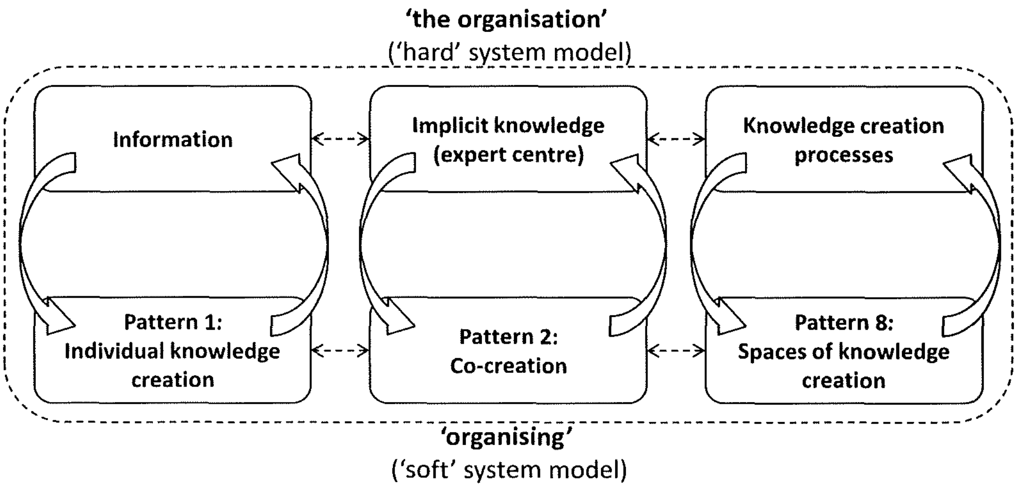



**Figure 7-3: Reproduction of the mental space**

### *7.2.2.1 Organisation of information and explicit knowledge*

The first recursive interaction is between the provision of information and individual knowledge creation (pattern 1). Information acquisition and provision are essential for the organisational innovation capacity (macro level) as discussed by Cohen & Levinthal (1990) and identified in section 5.3.1 (page 178). The acquired and provided information within individuals' interactions (micro level) can lead to information overload or can be processed into a creative idea (chapter 6, pattern 1 on page 199). Information overload occurs within a structured system in which individuals have many regular formal meetings and share a high amount of emails per day. This information providing and sharing allows individuals to match their actions within different projects, but can result in information overload. Therefore, too much information constrains individuals when trying to produce creative ideas. This cycle of self-reproduction of information and knowledge prevents exploring and creating new ideas and solutions, but can enable an effective organisation.

In contrast, information is acquired and processed into a new idea, solution and approach when individuals are intrinsically motivated and can deeply engage in the essential task (chapter 6, pattern 1 on page 199). This engagement and self-determinant (intrinsic motivation) has been identified as essential for creativity by

Amabile and colleagues (Amabile, 1996a, 1996c, 1997, 1998; Amabile, et al., 1996; Amabile & Kramer, 2011). They furthermore emphasised that an organisational environment that facilitates intrinsic motivation and task engagement has a high level of autonomy. These findings are supported by several studies (Deci, 1980; Pink, 2009; Stone, et al., 2009). The momentary events of high autonomy are the *Freiraum*, which permits individuals to self-determine the level of task challenge in relation to their ability and skills. This enables individuals to step into the state of flow in which creativity can emerge (Csíkszentmihályi, 2008).

#### *7.2.2.2 Implicit knowledge management*

The second interaction is the implicit knowledge management and co-creation (pattern2). Grant (1996) emphasised that through the integration of knowledge resource new knowledge can be created. The acquisition and development of experts influences the innovation capability (section 5.3.1, page 178). These experts with their different abilities and perspectives can enable creativity within individuals' interactions. In a system that hires system immanent individuals through standardised profiling of candidates, the system reproduces its 'thought collective' (greater mental space). On the one hand, this permits building expert centres and enables efficient communication which is based on shared understanding. On the other hand, the 'thought collective' can produce groupthink within conversations. This reproduces the same perspective (mental space). Sutton (2007, pp. 52-58) argues that an organisation should hire people which it probably doesn't as yet need, because these are the employees which bring in different skills and can teach the organisation something new. Interviewees stated that the career system is based on validation by the management peer group, which has the consequence that employees who fit to the peer group are more likely to be promoted. Employees with critical and contradictory views to their peers are therefore unlikely to get promoted. This firstly has the consequence that controversial opinions are not expressed and maintained and secondly that the system reproduces system immanent management with similar perspectives. This can lead to groupthink and interactions, which prevents group creativity (Nemeth & Nemeth-Brown, 2003). In contrast, diverse individuals produce redundancy, but this redundancy requires the acceptance of different perspectives (dialogue) within momentary events of individuals' interactions (mental *Freiraum*).

Similarly to the hiring and developing of experts with similar perspectives, a 'thought collective' can be produced and maintained through networking (knowing-who). Spatial proximity and proximity within a network of employees produces spaces of regular interactions. These regular interactions establish strong ties and shared understanding and perspective (thought communities). The problem is that these individuals are likely to reproduce the same knowledge (mental space). This reproduction of the mental spaces enables a department to become an expert centre (for example engineering, marketing, controlling, quality centres). These expert centres build boundaries within the organisation because of their different thought collectives and thought communities (Hernes, 2004a, pp. 101-114). In contrast, blind dates (as discussed in chapter 6, pattern 2 on page 204) can prevent groupthink and build a network of many weak ties. Perry-Smith & Shalley (2003) identified that networks with many weak ties and ties outside the organisation facilitate creativity. Similarly, Nonaka & Takeuchi (1995, p. 81) stated that unusual communication channels, fuzzy division of functional department, and that strategic rotation enables us to understand the business from multiple perspectives and produces new knowledge. This redundancy of interacting 'thought collectives' can trigger changes in perspective and cause creativity to emerge. Furthermore, knowing-who can assist creativity as it facilitates support and trust in conversations. This can enable creativity in help seeking situations (Hargadon & Bechky, 2006). Know-who can establish trustful interactions, which enables the free expression of opinions and ideas and mutual inspiration. This indicates that knowing-who can establish 'groupthink', but can also provide the conditions for interactions in which creativity can emerge.

#### *7.2.2.3 Knowledge creation processes*

The last interaction between the macro level and micro level that produces the mental spaces are the knowledge creation processes. These processes are relevant for the organisation to create knowledge (Nonaka & Takeuchi, 1995). Organisational processes determine the (formal) interactions of experts from different organisational functions (expert centres). Similarly, internal and external information is acquired through standardised information processes. The organisation observes the environment according to their established processes. Structured information acquisition and knowledge creation processes can reproduce knowledge in different functions. New knowledge is created when changes in the environment occur. This reactive learning within the organisation enables an organisation to adapt to the environment. It allows also managing, for example, stocks of parts and quality problems in the field. Knowledge processes within the organisation enable regular communication between experts to exploit an existing innovation. Within these routines or standardised processes, action and interactions and thoughts are reproduced. This builds experience and expertise within the organisation (*thick of the action*).

In contrast, when individuals have the *Freiraum* to step outside the routine, they are able to work in a self-determined manner on an intrinsically motivated task. This enables knowledge creation outside the work routine and new knowledge creation within the organisation (self-reproduction). The *Freiraum* enables individuals to engage in tasks of opportunities and possibilities and allows exploration, creation and prototyping of new ideas. This proactive knowledge creation enables individuals to create change rather than to adapt to change from the environment. As Bakken et al. (2009b, p. 78) pointed out, organisations and their individuals and groups can choose to do things differently. Ultimately, this can lead to the generation of new ideas. This generation of new ideas is based on both experience (*in the thick of the action*) and the creation of new context and meaning (in *Freiraum*). Otherwise innovation is unlikely. Bakken, et al. (2009b, p. 83) pointed out this problem of *Freiraum* and necessary experience (*thick of the action*) as follows:

> "Employees in touch with the market and customers are disposed towards carrying out the programs and not changing them. Structural-critical information often fails to reach levels in the organisation that can take decisions over structure changes. In this respect the term redundancy can describe why innovations are unlikely." (Bakken, et al., 2009b, p. 83)

Managers, who have, in principle, the *Freiraum,* do not have the structural-critical information (observed or experienced *in the thick of the action*) and employees who have this information do not have the *Freiraum*. Therefore, both *thick in the action* and *Freiraum* are required to produce innovation.

From an organisational perspective, the reproduction of mental spaces is essential to build expert centres and to preserve implicit knowledge within the organisation. The experiences (critical information) and expertise are essential for the creation of valuable (appropriate, feasible, viable) ideas and for exploiting innovation. For the production of novel (original, unusual, different) ideas, the organisation requires redundancy within its mental spaces. This redundancy can be established through individuals with different perspectives, skills and experiences and the necessary *Freiraum* to create new knowledge (and not replicate it). From a system point of view, the system needs to enable the production of and movement between the *thick of the action* to *Freiraum* and back to explore and create new ideas and develop them into state-of-the-art innovation. If the newly created change (*Freiraum*) is not conserved in routine (*thick of the action*), the change will be momentary as the system reproduces its existing knowledge and not the created change. The system has not integrated the change.

The dynamic of the organisation of knowledge, creativity and innovation is furthermore dependent on the social interactions of the individuals within the organisation, the social space.

### 7.2.3 *Social space (social system)*

The social space consists of the social mechanisms that produce the local social spaces bound in time-space and the greater space (organisational culture) exceeding time-space. The social space of the organisation includes social networks and communities (Hernes, 2004a, pp. 115-124). Social actions are reproduced and produce the social structure of the system (organisation) as discussed by scholars such as Luhmann (1986, 1995, 2000, 2003), Giddens (1984) and Fuchs (2003, 2004). This self-reproduction is illustrated in Figure 7-4 (next page). The first discussed reproduction is the vision and leadership in relation to creativity and innovation.

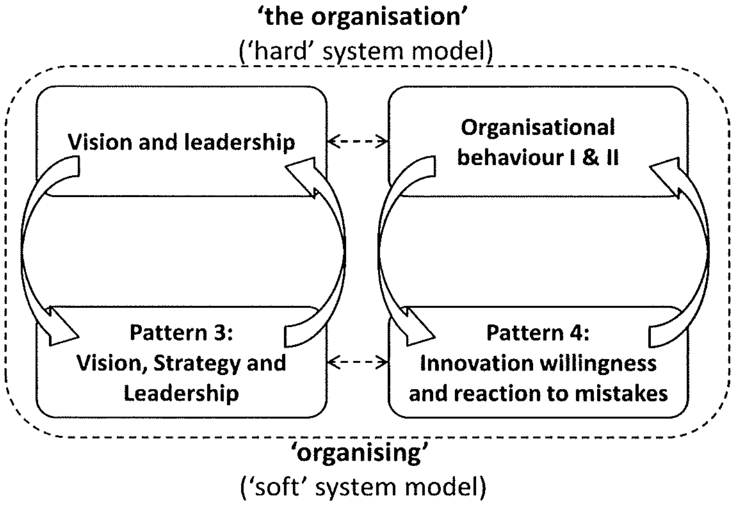



**Figure 7-4: Reproduction of the social space**

### *7.2.3.1 Vision and leadership to facilitate creativity and innovation*

The first social reproduction between social structures and social interactions are the vision and leadership practices. Leaders can facilitate and can prevent creativity (for example Amabile, 1998; Amabile, et al., 2004; Mumford & Licuanan, 2004; Mumford, et al., 2002). Amabile et al. (2004) identified that leaders who control their employees, provide non-constructive feedback (no appreciation and respect) and who have an inadequate understanding of the business operation can prevent creativity. Controlling leaders prevent employees a high level of freedom (*Freiraum*). Similar, opinionated leaders do not allow different perspectives or free expression and therefore reduce the *Freiraum*. Opinionated leaders have made up their minds without engaging with employees or before employee meetings and support only their own ideas. These leadership practices lead to a top-down approach as illustrated in Figure 7-5.


**Figure 7-5: Leadership practice of a top-down approach**

The problem of a top-down approach is firstly little 'room for manoeuvre' (*Freiraum*) is available for employees to develop novel concepts. Controlling and opinionated leaders who leave no 'room for manoeuvre' can produce unmotivated employees, who have been termed 'Bewohner' (inhabitants – satisfied but unmotivated employees). The 'Bewohner' are produced as employees only execute tasks (routine work) and cannot develop own ideas to fulfil tasks. 'Bewohner' reproduce their actions and interactions and are not open to change and willing to produce change. Therefore, leaders' social practice (social space) can result in the reproduction of the same actions and interactions (routine work). These leadership practices can make an organisation stable and align several employees to a clear goal, but make it unlikely that change and innovation will emerge.

Secondly, leaders often do not have structural-critical information (observed or experienced *in the thick of the action*), which makes innovation unlikely (Bakken, et al., 2009b, p. 83). Similarely, Amabile, et al. (2004) stated that inadequate understanding of the work by leaders can have negative impacts on creativity. For example, an interviewee explained a situation in which a top-manager praised a specific business function, which led to laughter in a large meeting. The reason for this was that the executive service of this business function was outstanding, while the service for non-executives was not so good. The leader or decision maker has a totally different experience of the organisation in comparison to most employees. This example shows that leaders might not have the information about the problems of the structure of the system. This can lead to strategic actions that do not solve the structural-problems. Another interviewee stated that a Japanese competitor appointed the tallest engineer as the project leader for the development of a small car. The reason for this was that the engineer knew the problem a person can have in a small car. He had the critical information. Therefore, leaders need to engage with their employees and understand the organisation (the system), work tasks and customer problems by being *in the thick of the action* to facilitate the system to produce innovation. The facilitation of creativity and innovation includes further leadership practices.

The identified vision communication and leadership practices such as challenging people to create their own ideas, empowerment, openness to new or unusual ideas, practice of shared values, balancing time, listening to advice and providing an open direction or vision (as discussed in chapter 5, pattern 3 on page 210) produce a combination of the top-down and bottom-up processes as presented in Figure 7-6.

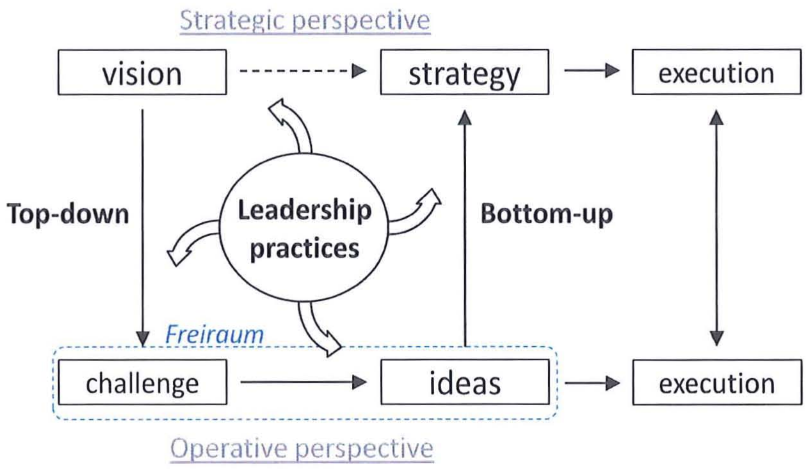



**Figure 7-6: Leadership practices of a top-down and bottom-up approach**

This top-down and bottom-up processes allow 'room for manoeuvre' and combines the strategic and operational perspectives. This facilitates the emergence of creativity and innovation. Figure 7-6 shows four stages which require specific leadership practices to enable employees to perform the cycle of top-down and bottom-up process.

(1) The first stage is the creation and provision of the vision. A vision provides open directions for the organisation or a specific project and provides the boundaries in which ideas should be created. An interviewee stated as an example the vision of BMW 'Freude am fahren' (joy of driving). This vision enables individuals to create new ideas that result in the 'joy of driving' and not in something that is not of value to its business. This vision can be more specific within a particular project, for example 'the next business car'. This vision needs to incorporate value for customers. Nonaka et al. (2008, p. 29) stated that "a vision is just a set of empty words if it doesn't have a context and a concrete mechanism for turning the vision into reality." Therefore, leaders need to communicate the vision (Andriopoulos, 2001) and transform it into a challenge.

(2) Transferring a vision into a challenge requires certain social leadership skills and practices such as energising others, practicing shared values such as appreciation and respect, empower employees and providing the necessary time to create new ideas.

Similarly, Amabile (1998) emphasised that leaders should provide direction and challenge, and autonomy and empowerment. This enables employees to contribute with novel ideas (as discussed in chapter 6, pattern 3 on page 210).

(3) Leadership practices such as empowerment, open direction and balancing time provide *Freiraum* in which individuals and teams can freely self-determine their actions. This 'room for manoeuvre' (local *Freiraum*) allow employees to explore and create novel ideas within a certain time period. Sutton (2007, pp. 179-181) describes this principle of *Freiraum* as "the best management is sometimes no management." Similar, several studies have found that employees with less supervision and high autonomy facilitate the production of high creative outcomes (Deci & Ryan, 1985; Pink, 2009). The open boundaries for this 'room for manoeuvre' is provided by the vision and the start and end time of the 'orientation phase' (as discussed in chapter 6, pattern 3 on page 210). This phase enables a time space (*Freiraum*) of no pressure, which is conducive to creativity (Amabile, et al., 2002).

(4) The created ideas need to be integrated into the strategic-road map to result in innovation and change. When ideas are rejected because of personal reasons by leaders, this can result in frustration of employees and produce 'Bewohner'. Therefore, leaders are required to appreciate ideas and opinions by individuals (practising values), listen to advice of employees and open up to unusual and novel ideas. This enables the combination of strategic perspective and operative ideas into a road-map towards innovation. Therefore, structural-critical information and strategic perspective are combined into novel and valuable ideas and strategic road-map.

These leadership practices at each stage enable the performance of the top-down and bottom-up process. The top-down and bottom-up cycle is enabled by 'situated leadership' and human and social bonding rather than by providing standardised practices (through a social architecture of pre-given values and practices). In this fluid process of momentary events, leaders are required to interact, bond, energise, challenge, empower, appreciate and listen to employees in such a way that each step of the cycle is facilitated. This leadership is similar to the transformational leadership style as discussed by Gumusluoglu & Ilsev (2009). This requires self-awareness of leaders of their action within interactions with employees. These situated leadership practices produce the local spaces in which creativity emerges and ideas are developed into innovation.

For the production of novelty, employees are required to accept the challenge and be willing to produce change (innovation willingness).

### *7.2.3.2 Behaviour and social interactions towards innovation willingness*

The second interaction that produces the social space is shared and cultivated behaviour. The shared behaviours (greater social space), which are conducive to the innovation performance, are practising shared values, motivation, open communication, openness to change and risk-taking. These practices produce the innovation willingness of individuals within their interactions (local spaces). The innovation willingness of an individual to create change is constrained or enabled by the collective innovation willingness (social structure) to bring the change into action and routine (development and implementation). This collective innovation willingness is constrained or enabled by reactions to mistakes (social structure). This indicates that the social actions and interactions have a feedback-loop, which can result in the reproduction of same actions and interactions rather than supporting change. This feedback-loop and reproduction of the social action and interaction is illustrated in Figure 7-7.

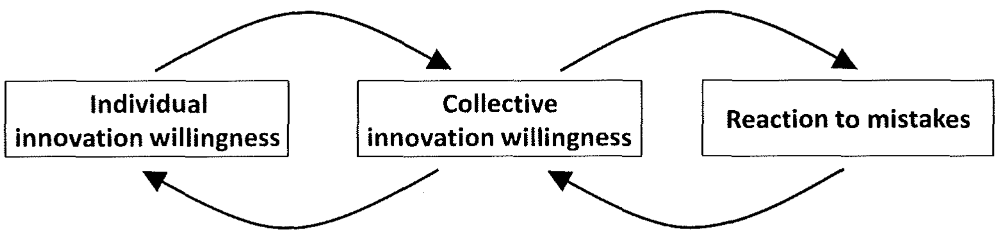



**Figure 7-7: Dynamics of innovation willingness and reaction to mistakes**

The reproduction of social action as illustrated in Figure 7-7 can lead to behaviour that is conducive to creativity and innovation, or to behaviour that prevents it.

The behaviour that prevents creativity and innovation includes punishment of mistakes. Punishment of mistakes within individuals' interactions leads to the behaviour that employees are not willing to explore, create and develop something new, as the likelihood of mistakes increases and therefore the likelihood of a further punishment. Punishment is often implicit and caused by behaviour such as someone expressing problems being perceived as someone who is not able to perform his/her work. This phenomenon has been stated as a metaphor: "shooting the messenger". For example, reporting mistakes can results in a bad validation of one's career assessment. Amabile (1998) stated that a culture of evaluation leads to focus on extrinsic rewards and creates a climate of fear, which both have negative effects on intrinsic motivation and therefore can kill creativity. Furthermore, this social behaviour results in not expressing problems and mistakes and consequently not identifying, solving and learning from them. It leads to the reproduction of the same actions and interactions as individuals reproduce the 'safe' actions and interactions to avoid punishment. Paradoxically, this behaviour can lead to the repetition of the same mistakes. Furthermore, it decreases the collective and individual innovation willingness.

Individuals that are motivated to create new ideas require commitment and resources. They need also input (open communication) and support from colleagues to create and develop ideas (Andriopoulos, 2001; Hargadon & Bechky, 2006; Pervaiz, 1998). Without these conditions employees are unable to implement any created changes and this reduces the innovation willingness over time. Therefore, individuals who were motivated get frustrated as no support is provided, and overtime, this results in resignation. This produces the 'Bewohner' (inhabitants) and high confirmatory of social actions. This confirmatory of social actions including mere-exposure effect (low redundancy) can prevent creativity (Andriopoulos, 2001, p. 836; Andriopoulos & Dawson, 2009, pp. 258-260). This indicates that certain social context produces confirmatory and low redundancy. It leads to the reproduction of the existing actions and interactions ('Bewohner') and ultimately reduces the organisational innovation performance as the collective is not willing to change their actions (no innovation willingness).

In contrast, within the self-reproduction, certain social behaviour permits change to occur through facilitating redundancy and autonomy. Individuals open up to change and playfulness (creativity) in an environment of safety, free of stress, high level of freedom and social interactions of open communication and appreciation (as discussed in chapter 6, pattern 4 on page 216). This is supported by findings from previous studies (Amabile, et al., 1996; Andriopoulos, 2001; Oldham & Cummings, 1996). These social practices produce a social *Freiraum*. This social *Freiraum* established through appreciation of unusual ideas and opinions, in particular by leaders, provides social reward. It facilitates individual innovation willingness. Furthermore, social *Freiraum* allows individuals to express unusual ideas and discuss them in open conversations. It enables groups to openly informing and 'include colleagues' ('Mitnehmen') and allows open conversations (dialogue). In the dialogue different and conflicting interests (dialectic) can be unified into a new idea (synthesis) (Nonaka, et al., 2008, pp. 30-33). This can establish collective innovation willingness as interests of several individuals were included and considered and individuals were able to developed own ideas. These effects are unlikely within normal and efficient work routines (low redundancy), as individuals perform according to their objectives, timelines and routines.

Furthermore, ideas need commitment and resources for their development into innovation. This includes risk-taking (Yusuf, 2009). The problem is the high level of uncertainty of novel ideas. Decision makers are not willing to make a decision based on uncertainty and therefore do not take risks. Uncertainty and complexity in decision making can lead to reproduction of the same actions in organisations (Luhmann, 2000). Within uncertainty, it is essential to get employees moving, observing, updating, and arguing about feasibility and plausibility (Weick, 2012, p. 265). This is the process of constant sensemaking, while moving forward in the uncertain process of the development of novelty. This process is similar to the spiral between the *thick of the action* and *Freiraum* (as discussed in section 6.13 on page 256 and section 7.3, page 296). Furthermore, risk-taking includes having the confidence and trust in employees to deal with problems and mistakes in subsequent processes (as discussed in chapter 6, pattern 4 on page 216). This requires dealing with mistakes. Sutton (2007, pp. 94-95) stated that IDEO has the innovation mantra of "fail early, fail often", which reduces the risk, as early identified mistakes can be stopped without resulting in high cost. Similar, problems identified early can mostly be solved with few costs involved. Failing requires the necessary social *Freiraum*, which provides a space of safety in which individuals are not punished and judged. Within these '*Freiraum* projects', no external reward, validation or judgment of employees is permitted. This is similar to the 'sub-marine' or 'bootleg-projects' (will be discussed in section 7.2.4.4, page 293). In this *Freiraum* individuals can safely and freely create and develop novel ideas by self-determine their action and follow their intuition.

Additionally, to facilitate the innovation willingness and positive reaction to mistakes within the organisation, an innovation director emphasised that openly showing success stories of individuals and teams who have created ideas and developed them into innovation can have a positive effect on the organisational innovation willingness. This shows that new ideas and change are valued. This has been institutionalised with an open online innovation community at Daimler AG.

Conclusively, the social behaviour and leadership practices that produce unmotivated employees ('Bewohner') cause a system to reproduce its own existing actions and interactions. Change can occur by providing social *Freiraum*. Social *Freiraum* and innovation willingness can reinforce each other and facilitate the emergence of change. Furthermore, social behaviours such as support and a high level of freedom and trust have been identified too be conducive to creativity and innovation.

### *7.2.3.3 Social ambience and trust*

Social factors such as social support, level of freedom and trust enable change to occur within the self-reproduction of the system as illustrated in Figure 7-8.

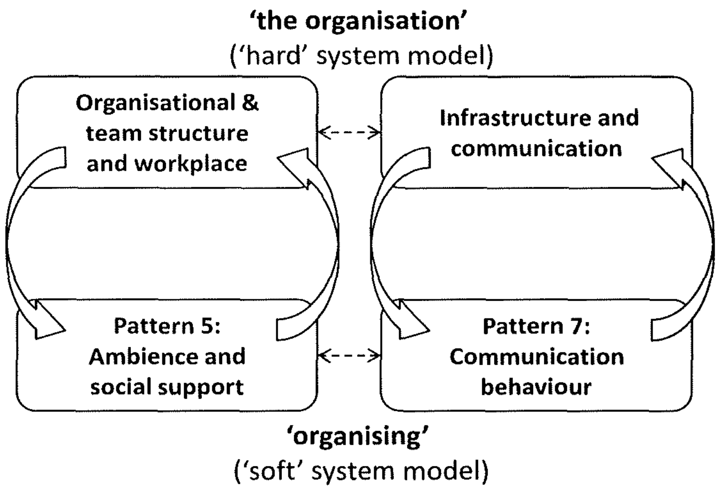



**Figure 7-8: Reproduction of social and physical space**

The social support, and a high level of freedom (as discussed in chapter 6, pattern 5, page 225) and trust (as examined in chapter 6, pattern 7 on page 232) can facilitate the social *Freiraum* in which dialogue emerges. A high level of freedom can trigger the exploration of novel pathways, playfulness with ideas and engagement in the essential task (Oldham & Cummings, 1996). This allows individuals to interact in a playful way and to concentrate on the problem. This social *Freiraum* has been best described by Sutton (2007, p. 179) in an example at 3M as follows:

> "An HR-Manager once threatened to fire a scientist who was asleep under his bench. [The head of research and development] took the HR manager to 3M's 'Wall of Patents' to show him that the sleeping scientist had developed some of 3M's most profitable products. [He] advised, 'next time you see him asleep, get him a pillow'." (Sutton, 2007, p. 179)

Social *Freiraum* means allowing individuals to be themselves and self-determine their actions. The challenge is to identify those individuals who use the *Freiraum* to do nothing (inaction) and those who explore and create novel ideas.

The social *Freiraum* is also produced by trust and social support. Trust stimulates free and open communication (Amabile, et al., 1996). This can facilitate dialogue in which creative ideas can emerge. Similarly, supportive behaviour can lead to creativity in help seeking and providing situations (Hargadon & Bechky, 2006). Both the help seeker and help provider engage in a dialogue in which novel ideas can be created. In contrast to dialogue, social interactions of formal meeting and email communication can produce efficient communication but can make creativity unlikely, as this communication behaviour reproduces itself (will be discussed in section 7.2.4.2, page 291).

Conclusively, social behaviour such as a high level of freedom, support and trust can enable social *Freiraum*. This social *Freiraum* can enable creativity and innovation. These social interactions are highly interlinked with the physical and regulatory space of the organisation (as identified in section 5.4, page 181).

### 7.2.4 *Physical, virtual and regulatory space (organisational system)*

The physical, virtual and regulatory space incorporates budget, technology, processes, rules, resources and functions (Hernes, 2004a, pp. 85-99). The physical, virtual and regulatory space cannot reproduce itself, but influences the actions that reproduce it (Hernes, 2004a, pp. 85-99). For example, rules and processes that were successful in the past are reproduced by actors. Similarly, budgets can constrain or enable the actions that reproduce the budget. An interviewee emphasised that, "when you create great things, you make more money, which allows you to make even better things." Therefore, the physical, virtual and regulatory space can enable or constrain the space in which individuals create ideas and develop them into innovation. The organisational design (section 5.4.4 on page 186) represents the physical and regulatory space and includes the workplace, organisational and team structures, processes of knowledge creation, interdisciplinary working and methods-in-use (e.g. rules). The reproduction of the physical and regulatory space is presented in Figure 7-9.

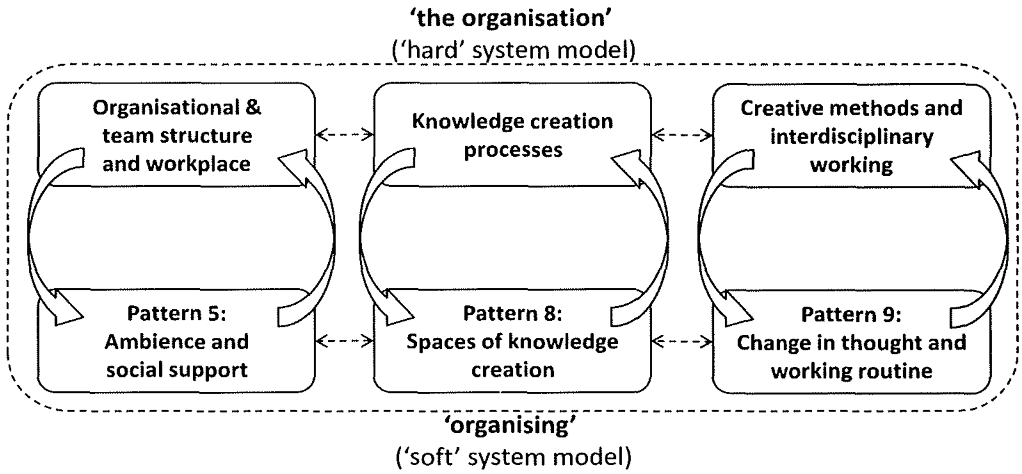



**Figure 7-9: Reproduction of the physical and regulatory space**

### *7.2.4.1 Organisational structure and workplace*

Physical spaces are discussed, which constrain or enable the actions and interactions that produce the budget that in turn allows building or renewal of the physical spaces. Physical spaces that facilitate informal conversations and dialogue enable interactions in which mutual inspiration and co-creation can emerge. These physical spaces can be coffee corners or specific rooms for idea workshops ('Innovationswerkstatt'). These physical spaces in which free conversations and dialogue can emerge can be seen as physical *Freiraum*. Arguably, the physical space is not the pivotal context that facilitates the dialogue, but can play an essential part. Nonaka et al. (2000) argue that the shared physical space in which individuals interact face-to-face enables shared context and is essential for knowledge creation. The physical space of *Freiraum* can be contrasted to physical spaces of *in the thick of the action.*

The physical spaces of *in the thick of the action* are the spaces in which individuals are immersed in the action and execute tasks such as assembly lines for the production of automobiles or customer retailers for sales conversations. These physical spaces were built for a specific task in which individuals create 'structural-critical' knowledge by experiencing the task. In contrast, dialogue and creativity require a physical space in which individuals are able to concentrate on and engage in a heuristic task and have the freedom and safety to play with ideas. For example, while being in the *thick of the action,* a mistake can be fatal when not concentrating on the execution of the task (for example steering heavy machinery). Therefore, the physical space needs to permit a safe environment, open communication to facilitate play and the creation of novel ideas. These open spaces of physical *Freiraum* should be associated with a context conducive to creativity such as a high level of freedom, free expression (open communication), safety, playfulness, dialogue, possibility rather than actuality and so forth. This is essential as individuals act context-specific to their environment. At Daimler AG this physical space is facilitated by the 'Innovationswerkstatt' (idea creation workshop) in which new ideas are created that resulted in innovation.

The reproduction of these spaces is based on the comprehension work of the management. The valuation of work as action and doing (as discussed in chapter 6, pattern 6 on page 228) reproduces spaces of *in the thick of the action* (for example factories with assembly lines, formal meeting rooms and engineering workshops) as managers invest financial resources in these spaces. The valuation of work as playfulness and thought reproduces creative spaces (for example innovation workshops and coffee corners). Depending on the comprehension work (mental space) of the system, the system produces its own physical spaces. This shows the strong interdependency between mental space and physical space as identified and discussed in section 5.5.1 (page 188). Both spaces are essential for creativity and innovation. Therefore, the self-producing system of organisation in which creativity and innovation emerges, self-produces both the physical spaces of *in the thick of the action* and *Freiraum.*

*7.2.4.2 Organisational processes*

Rules, technologies and processes (regulatory space) constrain or enable the actions and interactions that produce them. Rules, technologies and processes determine the routines of knowledge creation such as using IS/IT, conversations in meetings and face-to-face interactions or knowledge creation at the place of incidence (*Ort*).

Strict processes and cultivated rules reproduce the same rules. For example, an email results in a further email communication, or individuals go from meeting to meeting, which allows only little room for a different kind of communication (as examined in chapter 6, pattern 7 on page 232). According to Luhmann (1995), the system reproduces its own meaning, language and rules of communication as communication results in further communication. Formal rules and processes reproduce themselves as long as individuals interact with each other based on these rules. These communication rules can produce well-organized communication and matching of actions, which enables an efficient system. This allows exploitation of innovation.

Through redundancy (for example different communication channels), individuals can produce different knowledge creating routines and spaces. The routines and spaces of knowledge creation, which are conducive to creativity and innovation, are dialogue and gaining experience '*at the place of the incidence*' (*Ort*). Therefore, the system is required to enable individuals to produce these different spaces and knowledge creation routines when facing a heuristic task. This is only possible when the rules and processes incorporate redundancy and allow regulatory *Freiraum*. In this *Freiraum* individuals can step out of the rules of formal meetings and email communication and gain experience '*at the place*' (*Ort*) or can engage with each other in dialogue. This allows exploration of innovation.

A further reproduction mechanism of the regulatory space is the creative method-in-use and interdisciplinary working.

*7.2.4.3 Methods-in-use and interdisciplinary working*

Creative method-in-use and interdisciplinary working have the capacity to produce change in thought and work routine (as discussed in chapter 6, pattern 9 on page

243). The problem with organisation-wide architectures and methods-in-use is that they provide standardisation, which is not conducive to creativity (Gilson, et al., 2005). Therefore, a dynamic capability is required in which new patterns can emerge rather than the reproduction of established structures. Standardised creative methods-in-use (for example best practice) throughout the organisation reproduces actions and interactions. Best and good practices are essential to reduce the expenses and avoid continuous re-invention, as resources are limited. The problem with best and good practices is that, in complex or chaotic situations, they can result in disastrous outcomes (Snowden & Boone, 2007). Therefore, the system is required to dynamically produce actions and interactions which are relevant for the situation and task. This requires regulatory *Freiraum* in which individuals can observe and experience new emerging patterns and can use self-determined methods appropriate for the situation.

Furthermore, interdisciplinary working can establish a certain level of redundancy within the organisation. Nonaka & Takeuchi (1995, p. 81) emphasised that the co-working of different functional departments in fuzzy divisions and strategic rotation provide redundancy. Similarly, Jaworski & Zurlino (2009, pp. 50-97) argue that cross-linking knowledge drives innovation by overcoming internal boundaries, facilitating informal networks and establishing interdisciplinary teams. Within networks of organisations (and beyond), the establishment of knowledge diversity can produce creative communities (Cohendet & Simon, 2008). Additional, each project requires an 'alliance of innovators', which are motivated and drive the change (Jaworski & Zurlino, 2009, pp. 95-97). Integrating diverse experts who are mutually motivated or interested into the task can establish networked co-creation and communities of innovation. The continuous self-production of communities of innovation (spaces) through blind dates (as examined in chapter 6, pattern 2 on page 204) can establish high redundancy. This interdisciplinary style of working requires certain group processes and characteristics such as free expression and discussion of different opinions and perspectives (social *Freiraum*) as described in section 2.5 (page 53). Furthermore, distinct experts with distinct perspectives to avoid groupthink are required to build interdisciplinary groups that facilitate creativity. These experts are produced through team compositions of individuals from similar domains. These homogenous groups are essential for the development of experts (*in* *the thick of the action*), as individuals can learn from other experts and create experience by doing a related task. This is a crucial prerequisite for interdisciplinary working. Therefore, without experts (*thick of the action*) group compositions in *Freiraum* are unlikely to be diverse and do not produce new task context and meaning in conversations.

In addition, time and financial resources are essential factors within the reproduction of the regulatory space.

#### *7.2.4.4 Time and financial resources for production of the regulatory Freiraum*

Financial and time resources (regulatory space) constrain and enable the actions and interactions of individuals that produce them as illustrated in Figure 7-10.

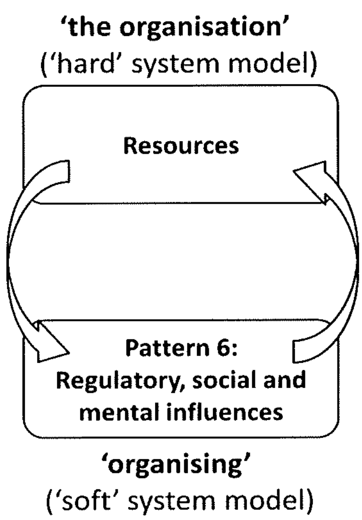



**Figure 7-10: Reproduction of regulatory space**

The organisational structure and processes determine the time resources. These resources constrain or enable certain individual interactions. Time pressure is produced by a 'highly clocked' organisational process (as presented in chapter 6, pattern 6 on page 228). This process is designed for efficiency to bring, for example, a product quickly onto the market, to integrate the multiple objectives and interests into a structured and efficient process and to preserve established knowledge. At the same structured processes allow little 'room for manoeuvre' (redundancy) and produce time pressure. Time pressure prevents creativity (Amabile, et al., 2002). It prevents employees from engaging with problems to solve them creatively and opportunities to produce new ideas. Therefore, processes require a certain level of flexibility (redundancy) in which spaces of creative problem solving (*Freiraum*) can emerge. These *Freiräume* (plural) are required to be produced dynamically by the individuals to solve problems and conflicting objectives through dialogue. Without a certain level of redundancy in the regulatory space (e.g. processes) *Freiraum* cannot be produced.

The organisational processes and structures (regulatory spaces) are produced by the management, while staff can generally do little to influence them (Hernes, 2004a, pp. 98-99). Therefore, the production of the organisational structures and processes, which result in either 'clocked processes' or processes with certain level of flexibility and freedom, are constituted by work comprehension of the management (as discussed in chapter 6, pattern 2 on page 204). For example, the valuation of work as 'doing and acting' results in processes and work routines in which employees are required to follow the process and execute the task. The valuation of playfulness and thought can establish processes and routines in which regulatory *Freiraum* (free time spaces) can be produced. These free time spaces (*Freiraum*) have been termed the "fifteen percent rule" (as examined in chapter 6, pattern 6 on page 228). Jaworski & Zurlino (2009, p. 123) stated the fifteen percent rule as the "Freiraum-model". These free time spaces (regulatory *Freiraum*) allow individuals and teams to follow their hunches (intuitions) when management think these hunches are wrong. Furthermore, Jaworski & Zurlino (2009, p. 123) argue that innovation is often generated within self-established *Freiraum*, which consists of the so-called, 'submarine-projects' ('U-boot-Projekte') or 'bootleg-projects' (Jaworski & Zurlino, 2009, p. 125). These projects run out of sight of the management. When the concept or prototype has established a certain level of readiness (has been tested for feasibility and viability), they are presented to management; they surface like a submarine. This regulatory *Freiraum* is produced by time and financial resources and requires self-initiative ('Eigeninitaitve') (Jaworski & Zurlino, 2009, p. 123).

In other words, creativity and innovation requires (2) innovation willingness and (3) *Freiraum* (time and budget). This enables (1) experts and teams to employ the resources in a self-determined manner and follow unconventional ideas. The challenge of provideing Freiraum is always the misuse for self-interest, rather than self-determined actions to explore and create ideas.

### 7.2.5 *Conclusion on self-reproduction of the system*

The discussion has identified the mechanisms within the self-reproduction (recursive interaction between 'the organisation' and 'organising') that can produce spaces of low redundancy and autonomy (*in the thick of the action*). This enables actions and interactions of efficiency, allows exploitation of innovation and builds expert centres. On the other hand, mechanisms and dynamics that produce high level of redundancy and autonomy have been identified and discussed. These allow the production of *Freiraum*. This *Freiraum* enables self-determinant actions and interactions (following hunches and unconventional thoughts), exploration of innovation and build spaces in which new context and meaning can emerge. The production of the different spaces through the mental, social and regulatory (physical and virtual) spaces is illustrated in Figure 7-11.

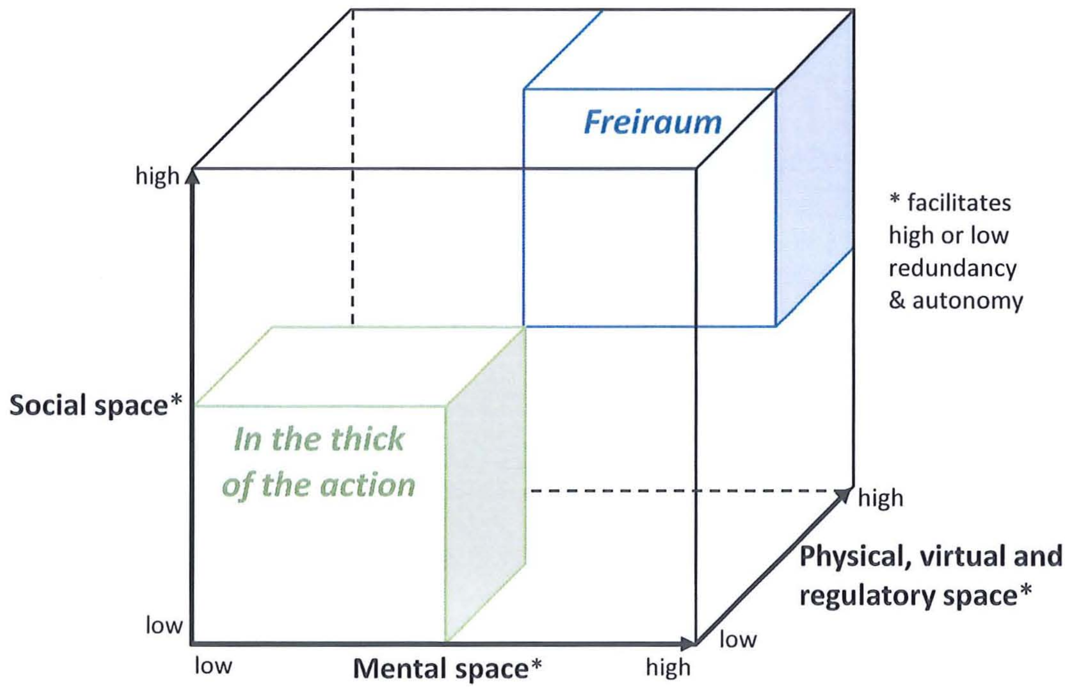



**Figure 7-11: Production of *in the thick of the action* and *Freiraum* through the mental, social, physical, virtual and regulatory spaces**

Figure 7-11 shows the ratio of different mechanisms and dynamics that facilitate or prevent redundancy and autonomy. *Thick in the action* is produced when the mental, social and regulatory (virtual and physical) spaces generate low redundancy. *Freiraum* is established when these spaces facilitate a certain level of redundancy and autonomy. A space outside the *thick of the action* and *Freiraum* is neither efficient nor provides it an environment for high creativity. The space of exploitation and efficiency (*thick in the action*) provides the context in which individuals can develop expertise by repeating certain tasks and learning from other experts (e.g. heterogeneous communities). In contrast, the space of exploration and change (*Freiraum*) provides the context that enables humans to explore and create new ideas and change.

Creativity and innovation are the function of the system that dynamically produces the spaces of *in the thick of the action* and *Freiraum*. This interaction between the two spaces, driven by innovation willingness, produces a spiral of creativity and a process of innovation.

## 7.3 Spiral of creativity and process of innovation

The spiral of creativity is the process in which individuals create knowledge and build expertise (*thick of the action*) and produce new sparks and novel discoveries (*Freiraum*). It is a 'frozen' representation of the constant fluid flow of momentary events (Bakken & Hernes, 2006). This renewal process can result in the generation of creative (novel and valuable) ideas and solutions and in the production of innovative concepts and prototypes. The spiral of creativity is presented in Figure 7-12.

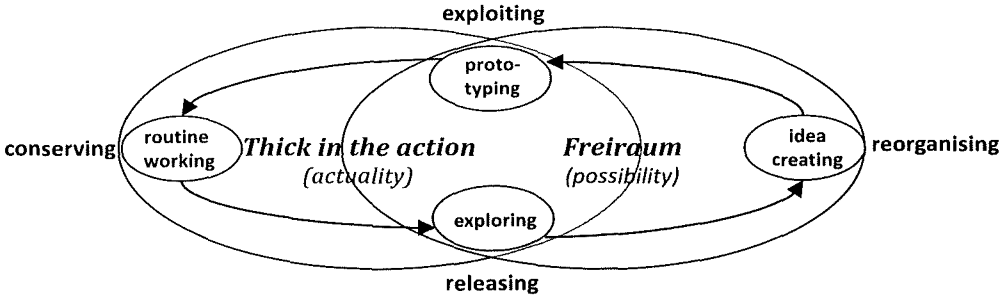



**Figure 7-12: Spiral of creativity and the different states of the system of the panarchy model (Gunderson & Holling, 2002)**

Figure 7-12 shows the four momentary spaces of routine working, exploring, idea creating and prototyping. Each space can be produced to provide the context relevant for the distinct phase of the creative process. Nonaka, et al. (2008, pp. 39-42) emphasised that organically configured (produced) 'Ba' (space) to fit to each situation makes the contradictions of freedom versus control or new knowledge creation and efficiency possible within an organisation. Similarly, Delemarle & Larèdo (2008, p. 191) stated that space makes it possible to overcome the 'ambidextrous organisation' towards more purposeful ways of promoting radical innovation. They emphasised that spaces produced by communities of practices (CoPs) provide the conditions which enable different configurations to achieve both exploitation and exploration.

To provide an explanation of change in a system the different configured spaces are linked to the different system states of change (as discussed in section 3.6.3, page 101). Furthermore, the context of the different phases is compared to the different phases of the creative process identified in academic literature. This reveals how the spiral can facilitate individual and group creativity.

### 7.3.1 *Spiral of creativity and different system states*

The four system states related to change as discussed by Gunderson & Holling (2002) are conservation state ($K$ phase), release state ($\Omega$ phase), reorganisation state ($\alpha$ phase) and the exploitation state ($r$ phase) (as discussed in section 3.6.3, page 101). These four phases describe the cycle of renewal of a system. The momentary space of (1) routine working, (2) exploring, (3) idea creating and (4) prototyping can be aligned with the system states, if one treats a group and individuals as a momentary (social) system within the organisation that renews its own task context. The panarchy model and social systems has been discussed as a sensemaking system (Berkes & Folke, 2002; Westley, Carpenter, Brock, Holling, & Gunderson, 2002). Individuals and groups as a system can perform a renewal cycle within the organisation through the dynamic production of spaces related to the different system states.

*7.3.1.1 Spaces and system states (potential and connectedness)*

The first space of (1) **routine working** is in principle the conservation stage (*K* phase) in which established change (e.g. innovative product) is reproduced. This is a stable system state, which allows the exploitation of existing innovation.

The (2) **space of exploring** is the release state (Ω phase), in which individuals enter a temporary space of high redundancy and autonomy (*Freiraum*). The shift from *K* to Ω is normally described as crises, creative destruction or disruptive change (Holling & Gunderson, 2002, p. 45). Rather than reactively adapting to a 'creative destruction', individuals and groups should proactively observe emerging patterns. This means producing the context, a kind of 'release' state that enables exploration of new emerging contexts. Scharmer (2001a, 2001b, 2007) describe this process as opening up to new emerging possibilities by 'seeing' and 'sensing'. Similarly, Sutton (2007, pp. 152-174) stated that the past behaviour becomes automatic (*in the thick of the action*), and when circumstances change or for the invention of new uses for old ideas and new combinations of old ideas, people need to engage in active or 'mindful' analysis. This requires changing from automatic to active thinking (Sutton, 2007, p. 153). Therefore, individuals and groups as sensemaking systems need to produce a 'release' state (space of exploration) to experience new emerging patterns and create new task context and meaning.

The (3) **space of idea creating** is the space in which the observed patterns are reorganised into a new idea. Individuals or groups enter a stage of novelty by moving away from actuality (observing) to possibility (reorganising). This is the reorganisation stage (α phase). The shift from Ω to α is a state of uncertainty and where new conditions arise from chaotic behaviour (Holling & Gunderson, 2002, p. 45). In the context of the spiral of creativity, this is the phase when new ideas arise from experience or in dynamics of social interactions. In this stage, individuals reorganise their knowledge and experience into a new ideas through analogy, combination or abstraction (as presented in Appendix A, page 357) and in deliberate or spontaneous reorganisation (Dietrich, 2004a). Groups reorganise their thoughts in conversation through utterances, specific social interactions and group processes (as discussed in chapter 2, section 2.5.3 on page 55) such as dialogue (McNamee &

Shotter, 2004). Sawyer (2007, p. 81) stated that the new idea (spark) is deeply embedded in the knowledge of prerequisite stages and social interactions.

The (4) **space of prototyping** is the exploitation state ($r$ phase). This stage of the spiral is idea prioritisation and development. This stage consists, for example, of contest competitions among entrepreneurial pioneers as stated by Holling & Gunderson (2002, p. 43). Within the context of the organisation, the newly created ideas have to contest for the resources required to develop them into a concept or prototype.

The last phase is the conservation stage ($K$ phase) in which the established change is conserved through (1) **routine working**. This space converts novelty into routine. The result of the spiral can also result in failure as either the idea cannot be brought back into routine (not feasible) or is rejected through the lack of value.

#### *7.3.1.2 Resilience*

Resilience is another dimension in the panarchy model by Gunderson & Holling (2002). Resilience permits the experience of wide-ranging change and yet still maintains the integrity of a system's functions (Holling, Gunderson, & Ludwig, 2002, p. 15). High resilience and low connectedness can provide the right conditions for creative experimenting (Holling & Gunderson, 2002, p. 40). This can be established within an organisation through the production of different spaces. *Freiraum* permits high redundancy (low connectedness) and *thick of the action* allows maintaining the integrity of a system's functions (high resilience). Groups maintain operations of the organisation through spaces of *in the thick of the action*, while other groups at the same time perform a creative experiment (*Freiraum*). This reduces the system-wide costs of failure (Holling & Gunderson, 2002, p. 40) and establishes a sustainable organisation of exploitation and exploration.

The production of the different spaces of *in the thick of the action* and *Freiraum* is furthermore linked to the creative process identified and discussed within the literature.

### 7.3.2 *Spiral of creativity and the creative process*

The spaces of the spiral of creativity interlink with the main phases of the creative process. Lubart (2001) has identified and discussed several main phases, and pointed out that the creative processes incorporate many sub-processes. Therefore, the main phases of the creative process should not be interpreted as a linear process, but rather as a simplified model of the fluid process of momentary events in which multiple sparks and discoveries are created.

The main phases of the cognitive process of creativity are problem identification, problem definition (preparation), incubation, illumination and verification (Lubart, 2001). These phases of the creative process are compared to the spaces of the spiral of creativity as presented in Table 7-1 (next page). The creative process should not be seen as a step-process or a routine, but rather as supporting phases to create knowledge, experience, sparks and new discoveries in the fluid process of momentary events.

<table>
<tr><th colspan="15">The spiral of creativity and creative processes</th><th>Scholars</th></tr>
<tr><td colspan="6">Preparation</td><td colspan="3">Incubation</td><td colspan="3">Illumination</td><td colspan="3">Verification</td><td>Wallas (1926)</td></tr>
<tr><td colspan="2">Problem identification</td><td colspan="4">Problem definition</td><td colspan="3">Incubation</td><td colspan="3">Illumination</td><td colspan="3">Verification</td><td>Lubart (2001) (extension of the 4-stage model)</td></tr>
<tr><td colspan="4">Task presentation / problem or task identification (intrinsic motivation)</td><td colspan="5">Preparation (domain-relevant skills)</td><td colspan="3">Response generation (creative-relevant processes & intrinsic motivation)</td><td colspan="3">Response validation and communication (domain-relevant skills)</td><td>Amabile (1996a); Amabile & Mueller (2008)</td></tr>
<tr><td colspan="2">Problem construction (ill-defined)</td><td colspan="3">Information encoding</td><td colspan="2">Category search</td><td colspan="2">Specification of best fitting categories</td><td colspan="2">Combination and reorganisation of category information to create new idea</td><td colspan="2">Idea evaluation</td><td colspan="2">Implementation of ideas and monitoring</td><td>Mumford, Mobley, ReiterPalmon, Uhlman, & Doares (1991)</td></tr>
<tr><td colspan="3">Preparation (period of working hard, studying the problem and engaging with others involved in the problem)</td><td colspan="5">Time off (individuals change context and engage in conversation with others)</td><td colspan="3">The spark (during time off, deeply embedded in the knowledge and social interactions, built on sparks others have had)</td><td colspan="2">Selection (best ideas to follow up includes collaboration)</td><td colspan="2">Elaboration (working out ideas requires lots of additional ideas and bringing them together through collaboration)</td><td>Sawyer (2007)</td></tr>
<tr><td>Downloading</td><td colspan="4">Seeing (open mind)</td><td colspan="3">Sensing (open heart)</td><td colspan="2">Presencing (open will)</td><td colspan="2">Crystallising</td><td colspan="2">Prototyping</td><td>Performing</td><td>Scharmer (2007)</td></tr>
<tr><td>Space of routine working (actuality)</td><td colspan="7">Space of exploring (actuality-possibility)</td><td colspan="3">Space of idea creating (possibility)</td><td colspan="3">Space of prototyping (possibility-actuality)</td><td>Space of routine working (actuality)</td><td>Spiral of creativity (thick of the action & Freiraum)</td></tr>
</table>

**Table 7-1: Comparison of the several creative processes to the spiral of creativity**

#### *7.3.2.1 Space of routine work*

The **space of routine work** (*in the thick of the action*) includes problem identification and construction (preparation). Employees understand complexities within their work routine, while being in the *thick of the action.* This includes learning about new technologies, key customer demands and user experiences, social trends and so on. Furthermore, information is acquired and provided to identify key problems and trends, which enables individuals at Daimler AG to identify the most promising opportunities or most critical problems. These events *in the thick of the action* can be linked to, for example, the phase of problem identification and problem definition (Lubart, 2001). The orientation for the creation of innovation is provided by the organisational or project vision, which provides an open direction. This can be seen as an ill-defined problem (Mumford, et al., 1991) or as the task presentation (Amabile, 1996a). The vision must be novel and valuable to guide employees in the creation of state-of-the-art ideas and solutions. This identification of problems or opportunities or direction through the vision leads to the next phase or space.

#### *7.3.2.2 Space of exploration*

The chain of momentary events that allows individuals to produce the **space of exploration** (*actuality-possibility*) is the 'problem definition' (Lubart, 2001), 'change of context' (Sawyer, 2007, p. 81) and seeing and sensing emerging patterns (Scharmer, 2007, pp. 129-162) by stepping out of the work routine. This requires not only 'time off' as stated by Sawyer (2007, p. 81), but mental, social, physical and regulatory *Freiraum*. New contexts are created by observing and experiencing, while being 'at the place of most potential' (*Ort*) relevant to the task (seeing - Scharmer (2007)) and by openly engaging in dialogue with others (sensing - Scharmer (2007)). This allows patterns of new task context to emerge and facilitates change in perspective. Within organisations, patterns of new context emerge through observation in different departments ('hospitieren'), observation and experience in different places, countries and cultures (cosmopolitan - Weltbürger) and inter-organisational learning (as discussed in section 6.13.2, page 259). Furthermore, cross-linking of experts as pointed out by Jaworski & Zurlino (2009) and open innovation initiative to engage with key customers and users as described by von

Hippel (1988, 2005) and Chesbrough (2003, 2006) can enable new contexts to emerge. This space is the intersection in which established ideas clash and combine with insights from other fields, disciplines, and cultures, resulting in totally new ideas (Johansson, 2006). The intersection requires mental, social and regulatory *Freiraum*. Without allowing someone to step into a different field or someone's 'territory' (area of responsibility), the intersection (space of exploration) cannot be produced. This space of newly emerging contexts (intersection) and problem definition can result in 'idea pregnancy' (intrinsic motivation). It requires *Freiraum* in which individuals can self-determine their actions to explore the intrinsic motivated task. This enables individuals to produce the space of idea creation.

#### *7.3.2.3 Space of idea creation*

The chain of momentary events (fluid process) that produces the **space of idea creation** (*Freiraum - possibilities*) facilitates the creation of a 'new spark'. This has been stated as the illumination (Lubart, 2001), response generation (Amabile, 1996a), presencing and crystallising (Scharmer, 2007) and reorganisation of categories (Mumford, et al., 1991). The idea or spark is based on experience from the previous phases as emphasised by Sawyer (2007, p. 81). Similarly, Weisberg (2006, pp. 201-202) argues the importance of available information (experience) in generating novelty. The *Freiraum* allows individuals to focus on possibilities and provides moments without distraction and permits imagining and envisioning of an idea. The creation of a new spark can be achieved through deliberate-processing and spontaneous-processing as discussed by Dietrich (2004a). There are several creative mental modes for the production of a new idea, such as analogy, combination and abstraction (as presented in Appendix A, page 357). In conversations and interactions between individuals, the dialogue has been emphasised as the mode in which a group or collective produces new ideas (for example McNamee & Shotter, 2004; Nonaka, et al., 2008, pp. 31-33). This generative dialogue requires open communication and free expression of opinion and unusual ideas. This open and dialogical space of creativity is the mental and social *Freiraum*. In this space, different views enable a change in perspective on the task or problem (McNamee & Shotter, 2004, p. 94). It is the deep embeddedness of the spark in social interactions (Sawyer, 2007, p. 81).

Without these social interactions of openness, free expression and the acceptance of other views (social *Freiraum*), the creation of a new spark or idea is improbable. In organisations, this dialogue is very difficult and unlikely to occur in the work routine. Therefore, this phase is enabled through guided workshops outside the work routine. The dialogue can also occur dynamically within the work environment in moments of *Freiraum*. This can be supported by coffee corners or creative rooms (physical *Freiraum*), individuals being permitted a high level of freedom and relaxed atmospheres for individuals and groups (social *Freiraum*) and free time spaces being permitted within structured processes such as a fifteen percent rule (regulatory *Freiraum*). The created sparks and ideas in these *Freiräume* (plural) need to be selected and are followed up to identify and/or develop their feasibility, viability and value.

#### *7.3.2.4 Space of prototyping*

The 'selection' and 'elaboration' phases are the **space of prototyping** that brings the idea back into the *thick of the action*. This is the process from envisioning to enacting (Scharmer, 2007, pp. 203-214). The selection is at the beginning of the phase of prototyping. Sawyer (2007, p. 81) described the selection process as a following-up of the best ideas. It requires collaboration and social interactions to elaborate these ideas. The elaboration phase is the momentary events of bringing the prototype back into routine (*thick of the action*). It includes the creation of further sparks and bringing these sparks together into a new and valuable (feasible, viable) concept, prototype or action plan. The space of prototyping and developing ideas includes the complexity of different mental perspectives such as mutually exclusive or conflicting objectives and interests. It can result in conflict, compromise or in the creation of synergies (as discussed in chapter 6, Table 6-6 on page 209). Similarly, Nonaka, et al. (2008, pp. 31-33) described overcoming contradictions through the synthesis of thought (dialogue). Therefore, the space of prototyping requires mental, social and regulatory *Freiraum* to enable dialogue and to solve the contradictions creatively. This dialogue is similar to the dialogue of idea creation, but differs in the focus of the participants. In this dialogue, participants focus on developing the conflicting ideas into a synergy (possibility to actuality). Individuals develop the novelty to bring it back into routine (*in the thick of the action*). This new routine needs to be accepted by the employees of the organisation. Otherwise the change is only temporary and will not be preserved within the system. Therefore, the spiral is driven by the innovation willingness to explore, create, develop, enact and execute the ideas and to produce and accept change.

The context of the spaces of the spiral of creativity links to the influence factors of both individual and group creativity.

### 7.3.3 *Individual creativity and the spiral of* in the thick of the action *and Freiraum*

The spiral of creativity can enable individual creativity. The context of the spaces of the spiral of creativity is conducive to several individual creativity factors of (1) domain-relevant skills, (2) intrinsic motivation and (3) creative-relevant processes.

Firstly, **domain-relevant skills** including expertise and experience are essential for individual creativity (Weisberg, 2006, pp. 212-213). The space of *in the thick of the action* enables individuals to become experts in their domain by learning from other experts and to build up experience by executing tasks in a specific domain. Extensive practice and experience allows an individual to achieve world-class performance and to perform complex tasks (Weisberg, 2006, pp. 197-203). The space of routine working (*in the thick of the action*) allows individuals to perfect tasks by reproducing actions, generating experience and developing expertise. Weisberg (2006, pp. 199-203) stated that reproduction of actions must be contrasted with creating novelty. The first step of producing novelty and innovation is to make behavioural adjustments (Weisberg, 2006, pp. 199-203). This is enabled by producing the space of exploration in which new patterns of task context emerge. The spaces of reproduction and exploration produce important experience necessary for a creative performance. This experience is necessary as the production of novelty requires a great deal of information (Weisberg, 2006, p. 201). Experience and reproduction of tasks can lead to fixation. These are the mental models or inner world views and beliefs within an organisation (Senge, 2006, pp. 163-190). Therefore, individuals need to overcome fixation to create a change in perspective by creative-relevant processes.

Secondly, the creation of novelty requires the creation of new knowledge, a change in perspective and overcoming fixation of the deadlocked perspective established by routine work (**creative-relevant processes**). The creation of new knowledge has two views, namely, tension view and foundation view (Weisberg, 2006, pp. 52-54; 203-207; 302). In the foundation view, overcoming fixation involves understanding a situation, phenomenon or task so as to be better able to select the relevant information from the environment (Weisberg, 2006, pp. 114-118). The exploration of a phenomenon, while being at the place (*vor Ort*) enables individuals to observe and experience the phenomenon, problem or task through multiple senses. The *Freiraum* allows individuals to explore and create knowledge and deep understanding about a particular phenomenon, task and problem through deep engagement in the task. The tension view on the other hand involves breaking away from experience (Weisberg, 2006, pp. 203-207). This process has been described based on Buddhist traditions. It incorporates breaking away from the objectification through a beginner's mind as described by Rosch (2008) and Scharmer (2001a, 2007). This enables the accessing of one's pure experience. This pure experience or mindfulness in the Buddhist traditions has been described as following:

> "When you first become aware of something, there is a fleeting instant of pure awareness just before you conceptualise the thing, before you identify it. That is a state of awareness. Ordinarily this state is short lived. It is that flashing split second [...] just before you objectify it, clamp down on it mentally, and segregate it from the rest of existence. [...] That flowing, soft-focused moment of pure awareness is mindfulness." (Gunaratana, 2011, p. 138)

Rosch (2008), Scharmer (2001a, 2007), Weick (2012) and Weick, Sutcliffe, & Obstfeld (2008) describe the process of accessing the pure experience and making sense to generate a novel idea. The spiral of creativity supports in principle both the tension and foundation view of creativity. The tensions view is supported as 'pure experience' is created 'at the place' (*Ort*) about the phenomenon (space of exploration) and mental and social *Freiraum* is created, which allows overcoming the objectification and allows mindfulness. The foundation view is supported as observation and experience 'at the place' (*Ort*) and deep engagement of the task allow understanding the problem or task in more detail.

Furthermore, individual creativity incorporates spontaneous-processing and deliberate-processing (Dietrich, 2004a). Spontaneous-processing to create ideas is based on daydreaming and mind wondering (Dietrich, 2004a). This requires *Freiraum;* in particular social *Freiraum* to allow individuals to daydream or to ponder at work without being criticised for 'not working' or being lazy. Such situations are otherwise only possible under the shower or on the toilet. *Freiraum* furthermore enables engagement in the task without distraction, which allows daydreaming and envisioning of novel and original ideas or solutions. For example, allowing individuals *Freiraum* to be able to enter the state of mind of daydreaming by permitting them to take a walk outside the building or sitting in the coffee corner. Similarly, the deliberate-processing requires stepwise information processing (Dietrich, 2004a). Therefore, *Freiraum* is essential, as otherwise individuals are not able to concentrate and process complex tasks and produce novel ideas. For example, through attending several meetings a day, individuals are not able to concentrate on complex tasks. Therefore, they do not process them into new ideas and solutions. Additionally, *Freiraum* enables individuals to focus on possibility rather than actuality, which allows utilising the creative energy of individuals to produce novelty rather solving routine problems, for example how to present at the next meeting.

Thirdly, individual creativity requires **intrinsic motivation** as identified by Amabile (1985, 1996a, 1996c). *Freiraum* enables individuals to determine their actions themselves and therefore to engage in intrinsically motivated tasks rather than those driven by external motivation. *Freiraum* also allows individuals to step into the flow channel. This flow channel (ratio of skills and challenges) enables individuals to create new ideas and be creative (Csíkszentmihályi, 2008). The *Freiraum* encourages motivation within routine work, as individuals who created and developed the idea are motivated to promote the idea and bring it into routine. This can be compared to the motivation in the *thick of the action* without *Freiraum* as presented in Table 7-2.

| Type 1<br>In the thick of the action | Type 2<br>In the thick of the action<br>(Freiraum as prerequisite) |
|---|---|
| Routine working leaves no room for creating own ideas, therefore employees are only executing ideas and cannot develop own ideas. This has been stated as an effect of producing inhabitants (Bewohner), who might do a good job but are not motivated to drive change. | The *Freiraum* allows the creation and development of own ideas rather than executing other's ideas. This leads to the motivation to promote and implement the idea (*in the thick of the action* – type 2). This has been indicated in interviews in which work becomes fun (play) and people like to work overtime on the task as it is satisfactory. |
| This is the execution of action and interaction based on extrinsic desires, the so-called Type X behaviour (Pink, 2009, p. 76) | This is the execution of action and interaction based on self-determination and intrinsic motivation, so called, Type I behaviour (Pink, 2009, p. 76) |

**Table 7-2: Two types of working in the thick of the action (two types of motivation)**

Table 7-2 indicates the effect of *Freiraum* on individuals' motivation and innovation willingness. *Freiraum* is not only essential for creating novel ideas, but also facilitates the motivation to promote, develop and implement change.

The multiple factors identified in relation to the context of the spaces of *in the thick of the action* and *Freiraum* indicate that the spiral of creativity is conducive to the multiple factors of individual creativity. Furthermore, the spiral of creativity is conducive to group creativity.

### 7.3.4 *Group creativity*

Group creativity consists of group composition, characteristics and processes as discussed in section 2.5 (page 53). These factors produce momentary events of social interactions (spaces in motion), which permit creativity in groups to emerge. The spiral of creativity is conducive to the group creativity in several ways.

Firstly, the spiral allows diverse **group compositions**. The spaces of the spiral of creativity facilitate the creation of different perspectives and exchange of the different perspectives through dialogue. This diversity of distinctive perspectives is vital in group creativity to avoid 'groupthink' as emphasised by Milliken & Martins (1996) and Nemeth & Nemeth-Brown (2003). The important aspect for creativity is to bring these distinctive experts into conversation (space of exploration and idea creation) through blind dates (as examined in chapter 6, pattern 2 on page 204) or new communication channels. This establishes interdisciplinary teams with distinctive and diverse perspectives. In these interdisciplinary teams, the diverse perspectives need to be expressed, maintained and accepted (Nemeth & Nemeth-Brown, 2003). This allows the creation of different perspectives. As McNamee & Shotter (2004, p. 94) stated "the 'otherness' which enters into us makes us other."

Secondly, **group characteristics and processes** to establish dialogue are supported by the spiral. For the dialogue to emerge, the challenge in groups is to establish an open mode of creativity, namely, *Freiraum*. This *Freiraum* is produced through the social, mental and regulatory spaces. To establish mutual inspiration through different perspectives, social *Freiraum* is required in which individuals freely and openly express their perspective, unusual or crazy ideas, accept others view and can freely be themselves. The social *Freiraum* is established when the group itself permits its group members to freely act and interact and be themselves. This enables a level of safety which is conducive to creativity (Edmondson, 1999). This social *Freiraum* is in principle Buber's (1970) I-Thou. This establishes an authentic relationship between individuals. Buber (1970) calls it the 'sphere of between' ('Zwischenmenschliche') that allows dialogue (Friedman, 2007, pp. 98-99). Therefore, the dialogue is not one person's action, but the interactions of the group itself as a diverse and unified entity bound in space and time. Bakhtin (1981) describes this as the 'centripetal forces' (unity) and 'centrifugal forces' (diversity). The social *Freiraum* (context of social interactions) enables unification, while the mental *Freiraum* (diverse opinions and perspective) facilitates diversity. The unification of opinions and beliefs (no mental *Freiraum*) of absolute truth (monologism) leaves no room for different interpretations and no freedom (Bakhtin, 1981, pp. 17-18). Therefore, the mental *Freiraum* is the momentary mental space in which nothing is impossible and in which contradictory views can co-exist. This can be refered to the 'intermediate impossible', which form stepping stones to novel and valuable ideas (De Bono, 1990). Similarly, Sawyer (2007, p. 105) emphasises that many not-so-good ideas are required to produce the rare great idea. This dialogue that produces novel ideas often incorporates statements like "what if" and "go on". Such statements open up new fields of possibility (mental *Freiraum*) and create positive reinforcement for expressing an unusual view (social *Freiraum*).

Furthermore, dialogue conversations avoid statements like "this is not true" (avoid monologism) and "I don't like this" (avoid overruling others opinion). McNamee & Shotter (2004) argue that dialogue can be facilitated by telling a story and not speaking in an abstract way, because if someone disagrees nobody can say that the story is not true. Such conversational dialogue can help to accept different views and perspective and gives context to a perspective. Furthermore, an opinionated leader, for example can prevent the dialogue. Therefore, a regulatory *Freiraum* is required in which nobody can overrule others opinion because of hierarchical position or decision control. Management are not able to control creative groups because of the *Freiraum* which is necessary for the open mode of creativity. These creative groups can become a powerful movement or force to establish change in the organisation ("rocking the boat"). Therefore, management may be anxious about such open, free and creative groups and prevent the group *Freiraum* and group creativity to occur. This is established implicitly by undermining the confidence of employees, not allowing any other opinion through authority and facilitating a permanent atmosphere of stress. In such cases the organisation as a system needs to produce temporary regulatory *Freiraum* in which individuals are freed from the organisational hierarchy and processes. Furthermore, physical spaces such as coffee corners or creative rooms (idea workshops) might benefit groups in establishing a free and positive atmosphere outside the work and meeting atmosphere. The dialogical space (*Freiraum*) facilitates new context and creativity to emerge.

Thirdly, individuals need to create new context, meaning and significance to produce creative ideas. This can be established by allowing the intermediate impossible through expressing unusual ideas or connecting different ideas. This requires shared context on the one hand and the creation of new meaning on the other. Ba or Space allows individuals to share context and to create new context (Nonaka & Konno, 1998; Nonaka, et al., 2008, p. 35). This shared space is at best the place of most potential (*vor Ort*) relevant to the task, problem or opportunity (space of exploration). The space, in which new context and novel ideas emerge, is *Freiraum*. This *Freiraum* enables individuals to follow their hunches and intuitively create new context and meaning. For example, within the social *Freiraum*, loosening up assumptions and producing deliberately crazy connections can produce new context and meaning, which allows novel ideas to emerge. These novel ideas need to be followed up to become creative.

Lastly, contradiction and conflicting objectives and interests can occur when developing the new idea into a novel and valuable prototype or concept. Therefore, these contradictions need to be solved through dialectic and synthesis. Conflict and contradictions arise when bringing the ideas back into the routine (space of prototyping). Organisations are dialectical beings, as their employees face many contradictions (Nonaka & Toyama, 2002). The contradictions or conflicting objectives and interests can result in conflict (either or), compromise (neither nor) or synergy (both possible) (as presented in chapter 6, Table 6-6 on page 209). The solving of contradictions is based on the synthesis of thought and synthesis of actions as advocated by Nonaka, et al. (2008, pp. 30-33). The synthesis of thought is the dialogue as discussed above, in which individuals open up to conflicting perspectives, allow them to co-exist and try to bring them into synergy through a new idea. This co-existence of contradictions is the mental *Freiraum*. For example, antinomies (thesis and anti-thesis) produce a free space (*Freiraum*) in which both exist (sphere of transcends) (Kant, 1998). The solving of contradictions is the 'homospatial process' whereby two discrete entities occupy the same mental space, and the 'Janusian process' in which the solution comes into gestalt (Rothenberg, 1971, 1996). Bringing two opposites together is cognitively demanding as stated by Runco (2007, p. 29). Therefore, in the process of development and implementation of ideas, *Freiraum* needs to occur dynamically within the organisation to solve the contradictions creatively. Similarly, based on Hegel's account, Nonaka, et al. (2008, pp. 30-33) described that the world is an interlinked whole, and that new solutions are found in the contradictions of the parts (entity) and whole (flow). Furthermore, Nonaka, et al. (2008, pp. 30-33) argued that often these contradictions cannot be solved through thought and therefore require the synthesis of action. This includes going into the field to observe (observing 'at the place'), reflecting in action and thinking about the essential meaning of an action (Nonaka, et al., 2008, p. 33). Both approaches of synthesis of thought and synthesis of action are supported by the spiral of creativity.

The spiral of creativity is conducive to the multiple factors of individual creativity and group creativity. The production of novel, valuable, feasible and viable concepts and prototypes needs to be developed and utilised to create innovative products, services, processes or business. This is the process from creativity to innovation.

### 7.3.5 *From creativity to innovation*

The process from creativity to innovation incorporates the process of bringing multiple creative concepts, prototypes and action plans into one innovative product with an innovative production process, innovative customer service and innovative marketing strategy etc.

The project groups (smaller and faster systems) establish change in the organisation (greater and slower system), while the organisation (e.g. organisational core process) constrains or enables the project teams (e.g. to produce *Freiraum*). These project teams need to bring the multiple prototypes and concepts together and integrate them into one unified innovative product (e.g. Mercedes-Benz S-Class). This integration is vital for the production of innovation and has been stated by an innovation manager at Daimler AG as the structure that allows the multiple ideas and concepts to be unified into one innovation ('roter Faden der durch das Unternehmen geht'). A *highly simplified* illustration of this complexity is illustrated in Figure 7-13.

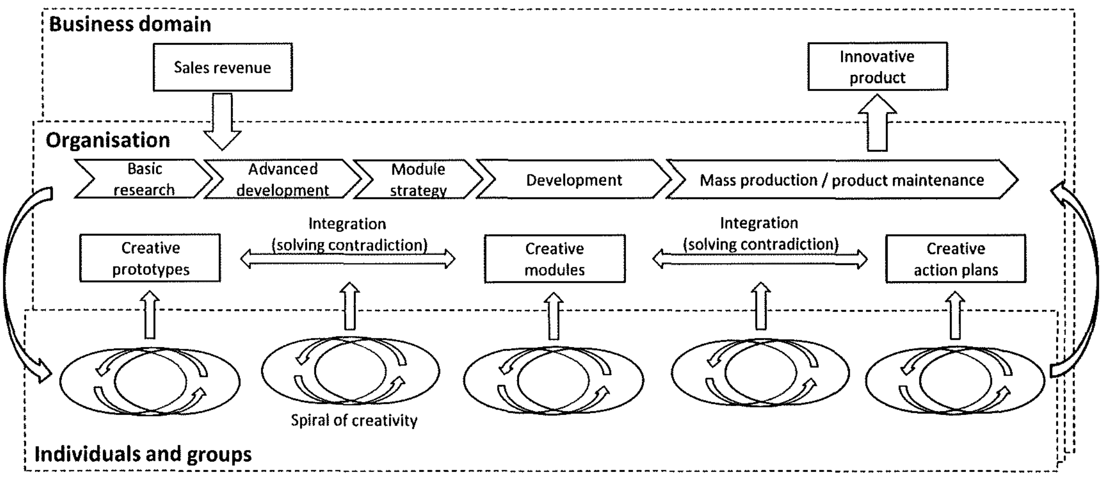



**Figure 7-13: Simplified model of the complex process from creativity to innovation**

Figure 7-13 shows the individual and group level (micro level) in which creative ideas, concepts and prototypes are created through the creative spiral. On the aggregated project level of the automobile ('Gesamtfahrzeug-Ebene'), different modules (for example design, light system, engine system, etc.) need to be integrated into an innovative automobile. At this macro level, contradictions and conflicting objectives ('Zielkonflikte') occur and need to be resolved creatively (as described in the spiral of creativity) to bring the novel concepts together into an innovative product.

The process from individuals and groups (micro level) to the organisation requires organisational knowledge creation. This organisational knowledge creation process is the process from individual to group to organisation through the SECI model by Nonaka & Takeuchi (1995). This bridge from individualised knowledge to socialised knowledge is overcome by language (Von Krogh & Roos, 1995). An organisation shares information and creates knowledge through the reproducing cycle in which individuals match their actions and share and combine ideas through utterances in meetings and information-sharing through technology. This is executed in routine communication (*in the thick of the action*). This allows unification of the multiple ideas, concepts and prototypes into an innovative product. The combination of multiple concepts through solving contradictions requires creativity. Therefore, 'room for manoeuvre' (*Freiraum*) or a certain level of redundancy is required. At the beginning of a project, the 'room for manoeuvre' (*Freiraum*) is wide open, whereas as the project develops, the 'room for manoeuvre' (*Freiraum*) decreases. This is illustrated in Figure 7-14.

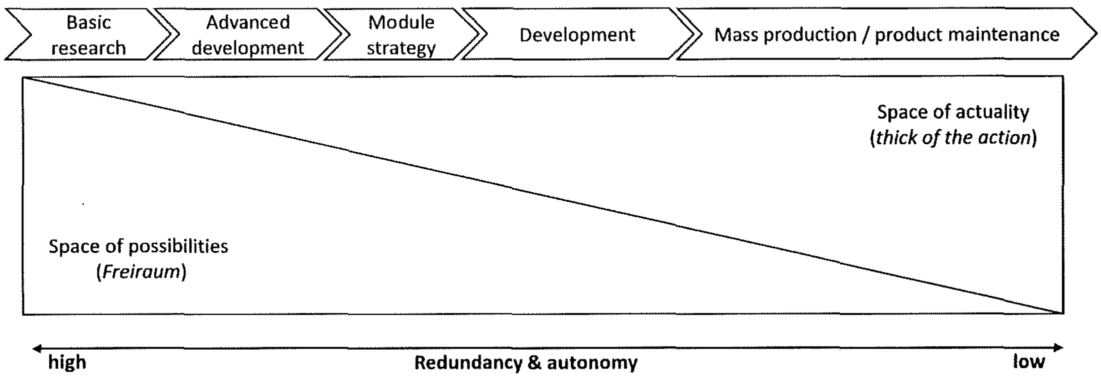



**Figure 7-14: Ratio between *Freiraum* and *in the thick of the action* in the innovation process**

For example, at the research stage the new automobile can be an electronic, hybrid or petrol fuelled automobile, while at the development stage the new car cannot be changed to a different power train system. Therefore, the production of novelty, in particular, breakthrough innovation can only be created and developed at the beginning of the project. This has been described as two phases of innovation, namely, the idea creation and the implementation phase (for example McLean, 2005). Similarly, West (2002b, 2003) argued that creativity is more evident at the beginning of an innovative project. Creativity is more evident at the beginning of the project, but is needed throughout the process to solve the contradictions and conflicting objectives and to integrate the multiple ideas into an innovative product (for example a light automobile with many customer features). Therefore, an organisation needs to have a certain level of redundancy to allow the production of a certain *Freiraum* throughout the processes. The level of Freiraum is dependent on the stage in the process as illustrated in Figure 7-14.

### 7.3.6 *Conclusion on the spiral of creativity and process of innovation*

The spiral of creativity between the two spaces of *in the thick of the action* and *Freiraum* enables individuals and groups to perform the creative process. It integrates the creative process into the system of the organisation as it supports several factors of individual and group creativity and is interlinks with the system renewal process. The system can create change in the larger and slower system (business domain) from small and fast systems (individuals and groups) by dynamically facilitating efficiency and exploitation (*thick of the action*) and creativity and exploration (*Freiraum*) through a certain level of redundancy and autonomy. The production of these different spaces requires decentralisation and dynamic integration of the decentralised spaces to facilitate creativity and innovation. This complexity of the dynamic mechanisms within an organisation to facilitate creativity and innovation are presented in the theoretical framework of the autopoietic system of the organisation of knowledge, creativity and innovation.

## 7.4 Theoretical framework: Autopoietic system model of the organisation of knowledge, creativity and innovation

The autopoietic system model of the organisation of knowledge, creativity and innovation consists of the greater space (organisational context) and the local spaces (context within individuals' interaction) and their recursive interaction (autopoietic organisation). The organisational culture, information and knowledge management, organisational design (greater spaces) constrain or enable the production of the local spaces of *in the thick of the action* (closed mode) and *Freiraum* (open mode). In these produced local spaces individuals shift between them to create change (spiral of creativity). This cycle is driven by the innovation willingness of the individuals. This theoretical framework is illustrated in Figure 7-15 (next page). In the theoretical framework innovation is produced when the related change is established on the organisational level. Change is a function of the system's self-reproduction (autopoiesis) and its inherent redundancy. The theoretical framework includes two kinds of change, namely, adaptation (exogenous) and creation (endogenous).

### 7.4.1 *Adaptation (exogenous) and creation (endogenous)*

In the theoretical framework, change in the system can occur in two ways: through adaptation (exogenous-endogenous) and through creativity (endogenous-exogenous).

Firstly, change can occur through external forces (exogenous). This is the adaptive process and a function of organisational learning. The adaptation process is based on observing change from the environment (structural coupling) and reorganising the internal structures and operation to adapt to the change (self-reference). For example, external forces such as the '2008 credit crunch' or a new disruptive technology by a competitor or new start up causes tremendous changes in the market and customer behaviour. If the organisation is not able to adapt to the changes and restructure its own operation, the autopoietic system (organisation) is not able to reproduce itself and will become insolvent. This is a reactive process of change and essential for the system's reproduction, vital to maintaining pace with the competition and consequently essential for its sustainability. The adaptation to change is based on actuality, as the change is present and required. This needs to be differentiated from the process of possibility (creativity and innovation).

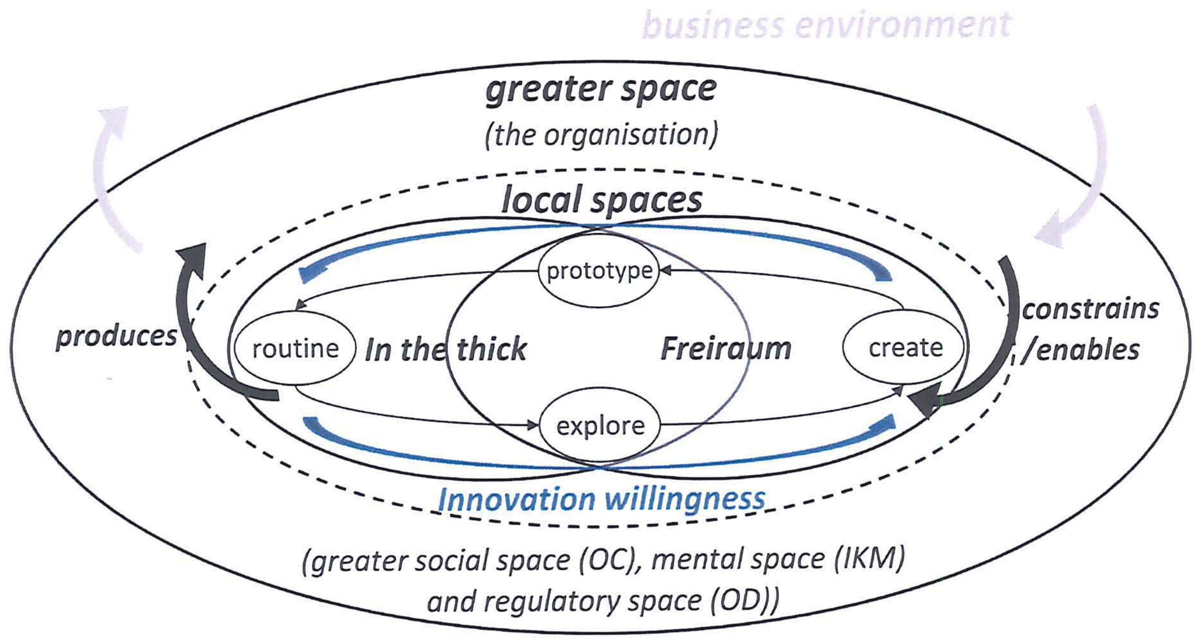



**Figure 7-15: Theoretical framework: Autopoietic system model of the organisation of knowledge, creativity and innovation**

Secondly, change can occur through forces within the system (endogenous). This is the creative and innovative process, which includes producing *Freiraum* and proactively changing the focus to a new phenomenon inside or outside the system (organisation) and observing new emerging patterns (proactive process). Bakken, et al. (2009b, pp. 78-79) stated this as the doing choice in which the system can orientate itself to differences and link their operations to them. Bakken, et al. (2009b, p. 86) stated,

> "every innovation or reform is about 'creating or utilising previously unrecognised social spaces' the organisational theorist P. Herbst observed (cf. Herbst, 1976, p. 48). These 'empty spaces' will no doubt be formally unregulated areas in an organisation." (Bakken, et al., 2009b, p. 86)

This unregulated space (*Freiraum*) is the space in which new meaning and context is created. Herbst (1976, p. 49) stated that the 'empty spaces' are "those regions within a social space which lie outside that which is prescribed and that which is forbidden by law and regulations" of the system (redundancy). These regions of the 'empty space' are the 'room for innovation and development' within the system (Morgan, 2006, p. 105). These unregulated spaces (*Freiraum*) enable new patterns of task context to emerge and, by filling the (empty) space with new meaning, new ideas can be created. Brook (2008, p. 11) exemplified this principle within the domain of the theatre, as one can take any empty space and can call it a bare stage. Filling an 'empty space' can be accomplished through individuals with different experiences come together and create new meaning, context and ideas. The *Freiraum* enables individuals and groups within the system to produce change by creating new ideas and proactively changing its structure and operation (autopoiesis) and producing innovation (heteropoiesis). As Bakken, et al. (2009a, p. 180) stated, greater redundancy enables a broader range of novelty to be absorbed and allows for a broader range of possibilities to become actuality to the organisation. This redundancy (*Freiraum*) enables the organisation to produce changes from within the system. This is a proactive process of change and essential for the establishment of innovation and leading the competition and consequently for the system's profitable growth and sustainability. This proactive change is based on possibilities as it is produced by filling 'empty spaces' and is a function of redundancy within the self-reproduction.

### 7.4.2 *Self-reproduction and redundancy*

The theoretical framework incorporates the autopoietic organisation (self-reproduction). The autopoietic organisation reproduces the system's mental, social, physical, virtual and regulatory spaces (self-referential cycle). For example, the mental context (knowledge creation) is reproduced through the self-referential cycle of the SECI model (Nonaka & Takeuchi, 1995). With low redundancy, the mental space reproduces the same knowledge (*in the thick of the action*). For the creation of novel ideas, the system needs to facilitate a high level of redundancy. This allows the creation of new ideas and change within the self-referential cycle (self-reproduction).

Redundancy can be understood as the different interpretations within communication and different modes of communication (Bakken, et al., 2009a). Furthermore, redundancy can be different communication channels, fuzzy structures, strategic rotation and informal communication networks (Nonaka & Takeuchi, 1995, pp. 80-82). Redundancy can be also loosely coupled systems (Weick, 1976). Linking the redundancy to the context of creativity, the 'room for manoeuvre' (redundancy) is the *Freiraum* in which individuals can explore new emergent patterns and create new meaning. *Freiraum* facilitates diversity, autonomy and self-determination of individuals and groups and enables them to perform the creative process by changing the focus from actuality to possibility and by following hunches and performing intrinsically motivated tasks.

*Thick of the action* produces efficiency and reproduces the same actions, while *Freiraum* allows change to occur within the self-referential cycle (self-reproduction). This is illustrated in the framework (Figure 7-15) through the two different space of *thick in the action* and *Freiraum* within the self-reproducing cycle. The production of these different spaces requires dynamic capabilities.

### 7.4.3 *Conclusion to the theoretical framework*

The theoretical framework can help in building a dynamic capability of the organisation of knowledge, creativity and innovation. It supports adaptation to change caused by external forces through reactively changing the operations and structures, and enables the creation of change from within the system through a high level of redundancy and 'room for manoeuvre' (*Freiraum*). New contexts and meaning can emerge within these 'empty spaces' (*Freiräume*). The framework integrates exploitation and exploration, which allows overcoming of the 'ambidextrous organisation' through the dynamic production of *in the thick of the action* (actuality) and *Freiraum* (possibility). The interaction of the two spaces driven by innovation willingness enables employees to integrate or dynamically produce the creative process within the organisational environment. Through the integration of creative ideas, concepts, prototypes and action plans, the organisation produces innovation.

## 7.5 Conclusion

The autopoietic system of the organisation of knowledge, creativity and innovation overcomes the static view of the organisation of mainstream organisational research. The theoretical framework provides a dynamic and emergent approach to creativity and innovation. This dynamic approach incorporates redundancy within the self-reproduction. This allows the dynamic production of different local spaces in which creativity emerges and the production of the greater space which facilitates innovation within the organisation. The theoretical framework incorporates the multi-level and multiple-factors complexity. Furthermore, it provides an explanation of how change emerges in individuals, groups and organisations and how it can be supported. It furthermore enables exploitation and exploration through the dynamic production of different spaces of different system states. This allows the production of innovation through filling 'empty spaces' rather than adaptation to external changes. The production of these spaces requires employees and leaders to be aware of their actions and interactions in the here and now. The framework contributes to organisational and management practices by drawing awareness to these chains of momentary events, which are the lifeline of the organisation for the continuation of its autopoietic reproduction and consequently its profitable growth and sustainability.

# Chapter 8 Conclusion

*"In living nature nothing happens that does not stand in a relationship to the whole, and if experiences appear to us only in isolation, if we are to look upon experiences solely as isolated facts, that is not to say that they are isolated; the question is, how are we to find the relationship of these phenomena, of these givens." Johan Wolfgang von Goethe* cited in Sepper (1988, p. 69)

***Keywords***

Contribution · Implications · Limitation · Future research ·

## 8.1 Introduction

This chapter summarises the main contributions of the research to theory. The implications of the thesis for studying the organisation of knowledge, creativity and innovation and for practitioners are discussed. Two main limitations of the study are acknowledged, which relate to issues of research design and outcomes. Lastly, new potential ways for resarch arising from the study, which are outlined in the research agenda.

## 8.2 Main contribution to theory

The research set out to answer the question,

> "what are the main factors and how do they underpin creativity and innovation in a large, global manufacturer company[4]?"

The main factors that underpin creativity and innovation are

> (1) diverse experts with experience produced in the thick of the action, (2) innovation willingness to create and support change and (3) *Freiräume* (plural) that allow the exploration, idea creation and prototyping of novel concepts and prototypes within an organisation.

These three factors produce a model of spaces that facilitate the spiral of creativity as presented in Figure 8-1. The production the spaces are constrained or enabled by the organisational culture, design and knowledge. Different organisational settings may have different ways of producing the spaces that facilitate creativity and innovation.

The factors underpin creativity and innovation in organisations by enabling individuals and teams to explore, create and prototype new ideas and concepts. The system of the organisation requires producing a space (*Freiraum*) in which new ideas can be freely and openly explored, created, expressed, prototyped and tested. These ideas and concepts need to be executed to be considered as feasible and valuable. Without the reproduction of new or different actions and routines ideas will not be

[4] In this case Daimler AG

developed into innovative products, services, processes or businesses. Therefore, the system of the organisation needs to organise itself and produce spaces (*thick in the action*) in which innovation can be executed and exploited. Within the execution of ideas and concepts new problems and opportunities emerge, which requires new solutions and ideas. Therefore, the creative spiral is an iterative process within the innovation process. *Freiräume* need to be produced dynamically when new solutions and ideas are needed.

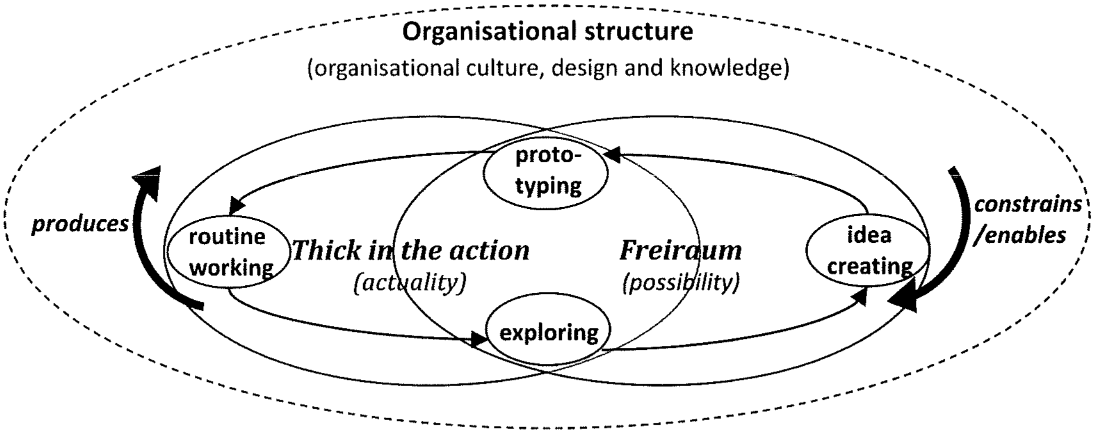



**Figure 8-1: The Freiraum model - Spiral of creativity embedded within the organisational structure**

The *Freiraum* model supports the management and organisation of mental, social and regulatory factors that produce spaces that drive the creative process. This enables overtime a change in organisational structure towards a creative and innovative organisation.

### 8.2.1 *Contribution to knowledge*

The main contribution to knowledge of this study is the investigation of multiple levels and factors within an organisation from an autopoietic system perspective that facilitate or prevent creativity and innovation to emerge. This investigation revealed that factors that produce the space of *Freiraum* enable high level of redundancy within the self-reproduction of the system. This allows the organisation to create novelty. Low level redundancy within the self-reproduction is needed to execute and exploit created novelty efficiently. This is facilitated by the factors that produce the space of *thick in the action*. This theoretical framework provides a new perspective on organisational innovation and individual and team creativity within an organisation.

The new theoretical framework

(1) combines the organisational knowledge creation theory with the theory of creativity and innovation in organisation to provide a unified framework of the organisation of knowledge, creativity and innovation.

(2) explains that the system's renewal and innovation process is not inherent in its components, but dynamically emerges from its autopoietic organisation and function of redundancy and autonomy.

(3) provides insights of the dynamic mechanisms of the mental, social, physical, virtual and regulatory context of an automotive manufacturer, Daimler AG that produces spaces in which creativity and innovation can emerge.

(4) combines the organisational context and context within interactions between individuals (multiple-levels) with the different main phases of the creative process. This provides an explanation of the multi-level complexity of creativity in organisations through the autopoietic organisation theory.

(5) contributes to the explanation of the interrelation between the system and individuals in which creativity emerges, which has been emphasised by Csíkszentmihályi (1990; 1996, pp. 23-50; 1999) as essential for the development of a theory of creativity.

(6) overcomes the contradiction of efficiency versus creativity and exploitation versus exploration through the dynamical production of different spaces relevant for the situation as advocated by Delemarle & Larèdo (2008) and Nonaka et al. (2008, pp. 39-42).

(7) provides guidance for individuals to dynamically produce the required spaces to perform the collective creative process within the context of a large German automotive manufacturer organisation.

(8) provides a dynamic organisational model, which draws awareness of the importance of situated practices and leadership of organising, strategising and sensemaking (Weick, 1979, 1995, 2012). These situated practices produce over time the greater space such as organisational culture.

(9) provides a human-centred approach, which enables individuals to be able to develop and achieve their potential through a space of freedom (*Freiraum*). This *Freiraum* allows individuals to self-determine their actions, follow their intuition and step into Csíkszentmihályi's (2008) mode of flow.

Furthermore, the theoretical framework has internal validity. It gains external validity and potentially wider application through its consistency with several findings of individual creativity (Amabile, 1996a; Weisberg, 2006), group creativity (Paulus & Nijstad, 2003; Sawyer, 2007), organisational creativity and innovation (Bakken, et al., 2009a, 2009b; Woodman, et al., 1993), creative process (Lubart, 2001; Sawyer, 2007) and organisational knowledge creation (Nonaka & Konno, 1998; Nonaka & Takeuchi, 1995; Nonaka, et al., 2008). However, future research is required to identify the applicability of the theoretical framework in different contexts and positioning it as a theory.

## 8.3 Implications for research

Scholars advocated more complete and integrated approaches of creativity and innovation in organisations. A more complete picture is needed for multiple levels and multiple influence factors of creativity and innovation within an organisation (Amabile & Mueller, 2008, p. 34) and overcoming the contradiction of exploitation and exploration (Delemarle & Larèdo, 2008; March, 1991). Therefore, it is useful to consider approaches that bridge the gaps between organisational structures and fluid process of individuals' interactions through theories such as structuration and autopoiesis (for example Bakken & Hernes, 2003a, 2006; Fuchs, 2003; Giddens, 1984; Goldspink & Kay, 2009; Hernes, 2004a; Hernes & Bakken, 2003), incorporate multiple influence factors (for example Amabile, 1996a; Woodman, et al., 1993; Zhou & Shalley, 2008) and allow the flexibility of different settings within an organisation through approaches of space and communities of practices (for example Amin & Roberts, 2008a; Davenport & Hall, 2002; Nonaka & Konno, 1998; Nonaka, et al., 2008; Nonaka, et al., 2000).

The research approach allows a complete and integrated approach of multiple-levels, multiple-factors and identification of different settings through space in relation to creativity and innovation. The structure of the organisation can be investigated by organisational mainstream methods such as survey data as discussed by Shalley & Zhou (2008). This permits the examination of the organisational context ('absolute view'). The investigation of the context within the fluid process of the interactions of individuals in which creativity emerges requires a different approach ('process view'). Approaches such as design patterns and pattern language as advocated by Iba (2010, 2011) and actor-network theory by Latour (2005) allow the examination of the local context of spaces within the fluid process of creativity and innovation. The combination of the two methodological approaches allows investigating and modelling the autopoietic system of the organisation of knowledge, creativity and innovation.

Bakken, et al. (2009a, 2009b) provide an autopoietic approach of innovation in organisations and emphasise that innovation is dependent on the level of redundancy. They do not present empirical data to support their proposition. Similarly, Iba (2010, 2011) provides an autopoietic system theory of creativity and an approach to investigate the creative process. This study has taken the approaches further and attempted an empirical examination. It revealed the dynamics that facilitate creativity and innovation in organisations. The thesis has not been able to assess the full complexity inherent in the dynamic autopoietic organisation of knowledge, creativity and innovation. This would have been an overly ambitious task to examine the many further influencing factors in organisations that impact the emergence of creativity and innovation within the self-reproduction. This is beyond the scope of a doctoral thesis. However, the research has built a composite picture of the complexity of the multiple levels and several multiple influence factors of creativity and innovation in organisations. It also elaborated a theoretical framework. This elaborated theoretical framework can redirect future research and opens up new ways of investigating the organisation of knowledge, creativity and innovation.

## 8.4 Implication for practitioners

The theoretical framework provides a dynamic organisational capability. This dynamic capability incorporates main contributions and implications to organisational and management practices. The theoretical framework can be applied to facilitate the production of spaces that facilitate creativity and innovation within an organisation.

### 8.4.1 *Implication for practice*

Firstly, the system in which creativity and innovation emerges is not a standardised structure, but rather a structure which is able to dynamically create change within its self-reproduction. Standardised (mental, social, regulatory) architectures provide either a static approach, which will result in the reproduction of ideas, or in a chaotic or unstable organisation in which innovation is unlikely. For example, an unstable or chaotic environment forces individuals to stabilise the organisation (Snowden & Boone, 2007). This makes innovation risky and unlikely as the production of innovation requires a stable environment with low costs of failure. Therefore, a stable organisation in which 'room for manoeuvre' (*Freiraum*) is possible provides the conditions and enables the system itself to produce innovation. This is established by the production of several spaces at the same time within the organisation as it provides high resilience (*thick of the action*) and low connectedness (*Freiraum*). In case of a failure of a team within *Freiraum,* the autopoietic reproduction is not at risk and the system's operation can continue, as teams still perform and exploit, for example, existing products (*in the thick of the action*).

Secondly, the dynamic capability enables the production of different local spaces through redundancy enabled by its greater spaces. Local spaces allow different configurations of context (Nonaka, et al., 2008, pp. 33-42) related to each situation or phase of the creative process. These different spaces need to be dynamically produced by the actions and interactions of individuals within momentary events. The dynamic production of, for example, *Freiraum* can be prevented by a single individual such as a controlling or opinionated leader. Therefore, situated practices and interactions are vital for the production of local spaces of creativity. Furthermore, for the practising of the interactions the surrounding or environment (mental, social and physical, virtual and regulatory spaces) needs to permit these actions and interactions. This indicates that the production of different spaces such as *Freiraum* cannot be simply implemented, it must be developed.

Thirdly, the innovative organisation incorporates both expert groups and 'communities of innovation'. On the one hand this requires the development of 'expert centres' (*thick of the action*). On the other hand the dynamic production of interdisciplinary 'communities of innovation' (*Freiraum*) is needed. 'Expert centres' that exploit innovation are enabled by ordered structures and processes. 'Communities of innovation' that explore innovation are produced by bringing the experts with shared task motivation together and permit them high level of freedom. Through the dynamic production of 'community of innovation' (experts with shared task motivation) breakthrough innovations as well as continuous improvement can be facilitated. This function that facilitates breakthrough innovations is the shift between the *in the thick of the action* and *Freiraum* (spiral of creativity). This shift is driven by the organisational innovation willingness. Therefore, the innovation willingness needs to be enacted through shared behaviour and leadership practices. This is essential for the organisational innovation capability as identified in the 'hard' system model in section 5.5 (page 188).

Lastly, the dynamic capability enables an organisation to overcome the 'ambidextrous organisation' as the spaces of prototyping and routine work (*in the thick of the action*) enable the exploitation of innovation and the spaces of exploration and idea creation (*Freiraum*) permit the exploration of innovation at the same time. This dynamic capability can be facilitated by several initiatives.

### 8.4.2 *Application of the theoretical framework in organisations*

The theoretical framework assists in building initiatives and draws awareness of the importance of the situations (the here and now) of individuals' interactions.

Firstly and most importantly, the interactions of individuals produce the local spaces bound in time-space and produce the greater space which exceeds time-space. These interactions of individuals (re)produce the spaces which constrain or enable the emergence of creativity and innovation. For the facilitation of creativity and innovation, situated leadership, cooperative interactions, social bonding and mindfulness-in-action, which produce *Freiraum*, are absolutely essential. These daily life-based practices that produce the spaces of creativity and innovation are the system's lifeline for the continuity of the autopoiesis and consequently for its profitable growth and sustainment.

Secondly, an innovative organisation needs to develop an open, decentralised but integrated and cross-linked organisation. This enables centres to produce the *Freiraum* and bring it back into routine (*thick of the action*). The open organisation allows learning from other organisations, domains and cultures by building strategic alliances or centres in specific regions (cosmopolitan - Weltbürger). For example, Daimler AG (at that time Daimler-Benz AG) opened a Research & Technology Centre in the Silicon Valley in 1995 to harvest ideas about new technologies and innovative products (Sutton, 2007, p. 157). Such centres are built in key markets and key areas throughout the world by Daimler AG to be able to experience different cultures of key markets and observe emerging patterns such as new technologies and social trends ('the Weltbürger organisation'). These centres require *Freiraum* to be innovative (Sutton, 2007, p. 157), but need to be integrated into the large organisation to bring ideas into routine and subsequently into the product, service, process or business.

Furthermore, physical, virtual and regulatory spaces (organisational system), can support or prevent creativity and innovation. Building expert centres is essential for the development of experts and for the preservation of knowledge. It is extremely important to avoid building centres which become closed systems ("their own principality"). Therefore the multiple experts need to be cross-linked throughout the organisation through networked co-creation. The networked co-creation can be supported through active support of the establishment of new communication channels and active building of 'communities of practice' / 'communities of innovation' by bringing together diverse experts with mutual task interests who do not know each other well (blind dates). Furthermore, initiatives need to produce a system that facilitates the production of *Freiraum* (autonomy and redundancy). Such initiatives can be coffee corners, which establish new interactions between individuals within spatial proximity. Similarly, creative rooms, which are associated with free expression and creative working, can establish creative behaviour and interactions between individuals. The fifteen/twenty percent rule (free time space) facilitates the *Freiraum* in which individuals and groups can self-determine their actions (Jaworski & Zurlino, 2009). This enables them to follow their intuition even when management disagrees.

The production of the 'empty spaces' (*Freiräume*) and 'communities of innovation' can be supported by supported by several initiatives. Firstly, this can be established by taking employees out of routine work, empowering and challenging them to produce novelty. The creation of opportunities and novel ideas (possibilities) is at its best when open and free cooperation is established beyond organisational hierarchies to unify strategic and operative perspectives. Secondly, the production of virtual spaces of possibilities and co-creation can facilitate the production of *Freiraum* and establishment of 'communities of innovation'. For example, a virtual space of possibility can be established through open online idea portals or open innovation communities (for user innovation and open innovation as discussed by von Hippel (2005), Sloane (2011) and Chesbrough (2003, 2006)). Employees and customers are asked to express and positively discuss and develop ideas. Customers can even be asked to develop ideas themselves (e.g. open source). This triggers individuals to change the focus from actuality to possibility. Important is the openness and transparency of this portal, as individuals are socially rewarded for expressing good ideas. Furthermore, managers can support ideas if they like them, and employees can express their interest in developing and implementing these ideas. This enables systematically building 'communities of innovation' with motivated experts. This requires providing the 'communities of innovation' the *Freiraum* to develop these ideas. Another effect is that ideas can be rated by every individual, which permits the selection of ideas that are supported by the collective. In contrast, closed idea portals in which ideas are not visible and an exclusive team selecting ideas does not have the same effects and does not provide a virtual *Freiraum*.

Lastly, '*Freiraum* centres' (idea / innovation workshops) in which teams can be guided through the creative process (spiral of creativity). There are two kinds of '*Freiraum* centres'. The first aims to produce new and valuable ideas for innovation. This includes

- providing an open direction (vision)

- acquiring and providing relevant information such as social trends
- identifying the places of most potential (*Ort*) to go there to generate experience and shared context
- guidance through the idea creation and selection process
- support of the follow up processes.

The second '*Freiraum* centre' aims to support teams in solving contradictions (conflict of objectives and interests) within the prototype and development phase. This includes

- identifying contradictions (efficiency versus quality, fuel efficiency versus customer features, novel design versus low cost production and so on)
- guiding the teams through the creative process (dialectic and synthesis) to establish at best an innovative product that has a great design, is easy to repair, is cost-efficient in production, is fuel efficient and incorporates many customer features.

Both '*Freiraum* centres' enable employees who are not used to working creatively to work creatively by guiding them through the creative process. A trained group leader can help to establish the context that produces the different spaces and as a result facilitate creativity and innovation.

These initiatives can support the creative and innovative process within organisations. The most important dynamic is the daily actions and interactions of individuals within momentary events (local space) as they produce the greater space, which in turn constrains and enables these actions and interactions. Therefore, situated leadership, cooperative interactions, social bonding and mindfulness-in-action by being in the here and now are absolutely essential to produce the local spaces and greater space which facilitate creativity and innovation.

### 8.4.3 *Potential difficulties of application of the theoretical framework*

Potential difficulties of the application of the model can be the shared beliefs, culture and design of the organisation. An organisation that has inherently a shared belief that does not value a space in which individuals and teams can self-determine their actions will prevent its production. Similarly, an organisational design and culture that constrains free exploration of unusual ideas might prevent the production of *Freiraum*. Therefore, each organisation might have different patterns that produce the different spaces according to its organisational design, culture and knowledge. For the application of the model the organisational structure needs to be understood to facilitate patterns that produce the spaces of *thick in the action* and *Freiraum*.

## 8.5 Limitations of the study

Each chosen theoretical stance and analytical lens brings with it unavoidable limitations. This section focuses on two main limitations, firstly, the unavoidable limitations by the theoretical stance taken. Secondly, specific perspective and context of a large German automotive manufacturer as case study.

### 8.5.1 *Theoretical stance*

The theoretical stance taken in this research was a pragmatic approach, which allowed the combination of the 'absolute view' and 'process view' into the 'autopoietic view'. Hernes (2004a, pp. 38-39) stated that this approach allows bridging the gap between social theory and natural science, while avoiding the 'naturalisation' of social systems. It permitted the explanation of how time-space context of human actions come into being and its continuity and reproduction (Hernes, 2004a, pp. 38-39). Furthermore, it allowed overcoming the duality of entities such as subject and object and process and structure. This approach is open to criticism in several ways.

Firstly, any theoretical stance will make some phenomena and data more significant than others, which results in focusing on certain data and leaving others unexplored. The relationships between the data, findings and theory are grounded within and structured by the approach of recursive interaction between the organisational context and context of human. A different theoretical stance might have led to signify other phenomena and data. This is by the nature of research an unavoidable limitation.

Secondly, the study incorporates bridging several approaches in order to integrate fields of organisational knowledge theory, social theory and theory of creativity and innovation. These different theoretical approaches of the different fields might incorporate dissonances in their different metaphysical approaches. This might be seen as theoretical shallowness, which is due to the nature of pragmatism as it might ignore the dissonances between different approaches.

Thirdly, the approach has focused on synergies at the empirical and theoretical levels in order to elaborate a composite and complete picture of the organisation of knowledge, creativity and innovation. This may subject the data to the researcher's interests, without exposing subjective interests to critical interpretation. To avoid bias by the researcher, the theoretical framework is deeply embedded in the empirical data, which keeps the researcher 'honest' as argued by Eisenhardt & Graebner (2007, p. 25). Furthermore, the paradigmatic stance avoids questioning the nature of reality and focuses on providing 'actionable knowledge'. This elaborated actionable knowledge is based on empirical data from which analysis was conducted. For the justification of the elaborated theoretical framework, the findings were presented and reflected by data subjects at Daimler AG. This provided a certain level of justification and allowed elaborating 'actionable knowledge'.

As pointed out, the paradigmatic stance taken in this research will have unavoidably influenced, to some extent, what was focused upon and emphasised in the investigation. A further main limitation is the specific context and perspective of the study.

### 8.5.2 *Specific context and perspective of the study*

The investigation has been able to address the phenomenon of the organisation of knowledge, creativity and innovation from a specific context and perspective of large German automotive manufacturer, Daimler AG. The specific context has two critical considerations.

Firstly, the findings of the single case study cannot be generalised in the scientific sense, but can refocus future research as stated by Flyvbjerg (2001, 2006) and Yin (2003, pp. 39-42). The specific context of the German automotive manufacturer Daimler AG has determined the outcome of the investigation. This specific context resulted in specific findings, which might not be applicable in different contexts. However, the pattern language permits reusability of the patterns and transferring the solutions into different environments as long the context of the situation or problem is similar (Rising, 1998a).

Secondly, a single case research might inherent some level of collective 'groupthink' about the phenomenon studied. The context itself is perceived through the eyes of the employees at Daimler AG. Therefore, the study is limited by a certain level of bias, which is unavoidable by the nature of a single case research. For the reduction of the collective bias inherent in the organisation the study included data subjects from diverse business functions and backgrounds including long-term employees and new employees who were able to reflect and compare their experience to the organisation were they worked beforehand. A systematic analysis of the different accounts from diverse data subjects allowed to some extent a critical reflection of the inherent collective bias in the case organisation.

Furthermore, the thesis draws links to existing theories, studies and findings, which allowed to some extent external validity and validating the collective 'groupthink'. Nevertheless, this study is limited by the specific context of the case organisation and perspectives of its inherent employees. It is for future research to investigate the potential applicability of the theoretical framework in further contexts.

## 8.6 Future research agendas

The agenda of future research of the investigation of the autopoietic system of the organisation of knowledge, creativity and innovation incorporates various objectives.

The applicability of this research would be greatly enhanced by investigating and testing the theoretical framework in different organisational contexts. Further research should investigate contextual-specific cases. These cases can provide further insights of the context and dynamics that produce spaces of creativity and innovation. This future research might reveal different context and dynamics that produce spaces of creativity and innovation. This would benefit from a careful theoretically and empirically designed investigation.

Future research would need to develop a research design and toolkits to investigate the recursive interaction between 'the organisation' and 'organising'. Some scholars have already started this journey (for example Bakken & Hernes, 2003a; Hernes, 2004a; Magalhães & Sanchez, 2009a). Theories such as the autopoiesis in biology and cognition by Maturana & Varela (1980, 1992), social autopoiesis by Luhmann (1986, 1995, 2009) and Fuchs (2003, 2004, 2008) dialectic of structure by Bhaskar (1978) and structuration by Giddens (1984) provide the theoretical foundations for such future research. These theories can be further developed to support the investigation of social systems as autopoietic systems as emphasised by Mingers (1995, 2002, 2003, 2004). Furthermore, theories such as the production of space by Lefebvre (1991), laws of form by Spencer-Brown (2008) and spatial construction by Hernes (2003, 2004a, 2004b) build the basis for the investigation of spaces and their continuous production and reproduction. On the basis of these theories, future research might produce research designs, methods and useful toolkits like the ones of system dynamics by Sterman (2000) and soft system methodology by Checkland (1999).

Another agenda is the investigation of the fluid process of creativity. This is a highly complex task, because of the contingent, fluctuate and context-specific nature of creativity. This requires useful toolkits to examine the fluid process of creativity. First attempts of this highly complex task have been made by Iba (2010, 2011). Another method of tracing the process of innovation is the actor-network theory by Latour (2005). The combination of these toolkits and methods with the approach of space and process-view by Hernes (2004a, 2004b, 2007) could provide a promising approach to examine the fluid process and different configurations of spaces in which creativity occurs. This could support the already in-depth research of the management of flow by Nonaka, et al. (2008). The suggested approach would allow the investigation of the context of the fluid process in organisations to provide insights for its management.

Forces, influence factors and their dynamics that produce spaces of creativity and innovation should be investigated to build the creative organisation. These mechanisms and dynamics should be linked to theories of individual creativity, group creativity and organisational creativity. This permits integrating contextual dynamics that produce distinct space or communities of practices to the factors of creativity and innovation. Some attempts are already executed (for example Amin & Roberts, 2008a). These identified dynamics might support the building of creative and innovative regions, cities and companies.

Future research might engage in investigations, which aim to identify further spaces in organisations that can facilitate creativity and innovation. Such spaces can be of a physical, virtual, regulatory, social and mental nature or a combination of them. For example, as information systems and technologies become more and more integrated in daily life virtual spaces that facilitate creativity are a promising field. Therefore, future research should investigate new technologies such as social media and its inherent social and cognitive context. These virtual spaces can foster the interconnectivity of individuals and the free exchange of diverse ideas. This is an essential field for creativity and innovation as initiatives such as open innovation become more and more important (Chesbrough, 2003, 2006; von Hippel, 2005).

These different research agendas can build on the research reported in this thesis and further develop the organisation theory of knowledge, creativity and innovation from an autopoietic system perspective. This thesis has filled an 'empty space' that allows the journey for such future research to begin.

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# Appendix A List of different creative cognitive modes and thinking styles

| Thinking style | Creative cognition | Scholars |
|---|---|---|
| Divergent thinking | Creation of numerous ideas and selection of 'best' ideas | Runco & Okuda (1988); Runco (1991); Runco, Dow, & Smith (2006) |
| Darwinian processing | Generation of variations / ideas that are 'blind' and are tested against the environment (evolutionary epistemology) | Campbell (1960); Simonton (1993, 1999); Dasgupta (2004) |
| Janusian thinking | Identifying and solving of contradictory viewpoints | Rothenberg (1971, 1996) |
| Bisociation (bottom up) / combination (top down) | Combination of two of more schemes / merging of two or more concepts into one new idea | Koestler's (1964); Welling (2007) |
| Analogical thinking and metaphor | Transposition of a conceptual structure from one habitual context to another innovative context | Dunbar (1995); Bohm & Peat (2011, pp. 17-26); Welling (2007); |
| Abstraction | Discovery of a pattern on a lower level which is abstracted and represented as a conceptual entity | Welling (2007) |
| Flow | An intense concentrated and committed information processing towards a defined goals to accomplish a creative insight | Csíkszentmihályi (1996, 2008); Dietrich (2004b) |
| Restructuration (Gestalt theory) | Change of representation (Umstrukturierung) of the problem allows better understanding of a phenomenon, which leads to a solution or idea | Duncker (1935, 1945) |
| Deliberate thinking (Top-down) | Conscious information processing of different alternatives until an solution is found | Weisberg & Alba (1981); Ohlsson (1984) |
| Unconscious or intuitive insights (Bottom up) | Unconscious or intuitive process of creative insight as humans intuitively perceive the 'fluid world' | Bergson (2005 [1910]); James (2009 [1880]); Dijksterhuis & Meurs (2005); Dijksterhuis & Nordgren (2006) |
| Beginner's mind (Bottom up) | Unbiased intuitive knowing or wisdom awareness in which creative ideas come spontaneous to one's mind | Rosch (2002, 2007, 2008); Scharmer (2007) |
| Network of sparks | Creative insights are created through the combination of many sparks and insights | Schilling (2005); Sawyer (2007); Johnson (2010) |

# Appendix B Detailed discussion of social autopoiesis

### Social Autopoiesis by Maturana

Maturana (1980, 1988) stated that social systems are not autopoietic, but are natural social systems, which consist of recurrent interactions and relations. Mutarana (1980, p. 11) defined the natural social system as follows:

> "[...] a collection of interacting living systems that, in the realisation of their autopoiesis through the actual operation of their properties as autopoietic unities, constitute a system that as a network of interactions and relations operates with respect to them as a medium in which they realize their autopoiesis while integrating it, is indistinguishable from a natural social system and is, in fact, one such system." (Maturana, 1980, p. 11)

In this natural social system theory, social systems require mutual acceptance, consists of a set of recurrent interactions and relations in which members join and leave, individuals can be part of many different social systems, change in the system can only occur through change of behaviour in individuals and social interaction of the system consists of language, emotions and bodyhood, which are the mechanisms whereby structural coupling of the social system takes place (Mingers, 1995, pp. 130-132). In this social system theory the system is not autopoietic. A social system theory, which is an autopoietic system is social autopoiesis by Luhmann (1995).

### Niklas Luhmann's social autopoiesis

Luhmann (1995) developed a autopoietic social system theory based on communication. This concept of social autopoiesis is based on the approach that,

> "social systems use communication as their particular mode of autopoietic reproduction. Their elements are communication which are recursively produced and reproduced by a network of communications

> and which cannot exist outside of such a network. Communications are not 'living' units, they are not 'conscious' units, they are not 'actions'. Their unity requires a synthesis of three selections: namely, information, utterance and understanding (including misunderstanding). This synthesis is produced by the network of communication, not by some kind of inherent power of consciousness, or by the inherent quality of information. [...] It is the network of events which reproduces itself and structure are required for the reproduction of events by events." (Luhmann, 1986, p. 174)

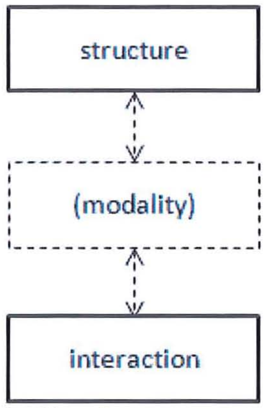
This means that communication as an event consists of the three indissoluble elements, namely information utterance and understanding, which enable further autopoietic operations to occur (Mingers, 1995, pp. 141-142). These units of the same system can be distinguished between information (hetero-reference - by asking for further information about information) and utterance (self-reference - by questioning the 'how' and/or 'why' of the communication) to achieve understanding (Luhmann, 1986, p. 174). In a simplified explanation, communication (between 'alter' and 'ego'), is established when 'alter' selects something as information first. The information is then uttered to 'ego' (including non-verbal communication). Understanding (including misunderstanding) occurs when 'ego' is able to observe the information and the act of utterance as separate selections (Luhmann, 1995, pp. 137-175). Communication is forced by its own structure to distinguish and to recombine information (hetero-referentiality) and utterance (self-referentiality) in order to establish understanding (Luhmann, 1986, p. 175; 1995, pp. 150-154). If the distinction is not established, the linguistic communication (noise) is only perception and not communication, because no understanding is established (Luhmann, 1995, pp. 151-153). Therefore, communication requires the autopoietic process of 'hetero-reference' or 'self-reference' to self-reproduce communication and therefore for the social system reproduce itself. Autopoietic self-reproduction results in temporary or momentary events of communication, which causes the system to be an emergence phenomenon (Hernes & Bakken, 2003, pp. 1514-1515; Mingers, 1995, pp. 144-145). For the system to continue, it must reproduce itself.

The communication in Luhmann's sense is separate from the meaning of the communicative act of sender-receiver as he proposes that only 'communication can communicate', which implies that consciousness is not something that enters communication (Borch, 2011, pp. 33-36). In other words by Hernes & Bakken (2003, p. 1514), they state that social and cognitive (psychic) systems co-evolve, but they are separate and form distinct environments to one another. As Mingers (1995, p. 144) points out; individuals will come and go but communication dynamics will remain within the social system. Therefore, each social system has its own communication dynamics and communication between two social systems can only be 'interpreted' by each system through its own self-reference. From this point of view, the autopoietic social system is a network of units of communication and not a network of individuals. To summarise Luhmann's (1995) autopoietic social systems, the social system is an operationally closed network of communications, which reproduces itself through momentary events of communication.

The 'Achilles' heel' of the social system theory by Luhmann (1995) is the radical separation of communication from spatiality and humans, as humans ultimately underpin communication and interactions (Mingers, 1995, pp. 148-150; 2002). Another theory which implicitly relates to autopoiesis is Giddens's (1979, 1981, 1984) theory of structuration, which centres individuals' interaction (agency) as the reproduction of the system structure.

### Anthony Giddens's structuration theory

Giddens (1979, 1981, 1984) introduced the 'theory of structuration'. This theory incorporates the self-reproduction of the social system through the recursive interaction of individuals (agency) and structure (Giddens, 1984, pp. 1-40). The structure is not the experience of the individual actor nor is it any form of social totality, it is the social practice ordered across time and space (Giddens, 1984, p. 2). Through the social activities of the agents the conditions are reproduced, which make these activities possible (Giddens, 1984, p. 2). Therefore, social structure is reproduced through the social interactions and activities of agents across time and space.




**Process of structuration and duality of structure. Based on Giddens (1984, pp. 1-40)**

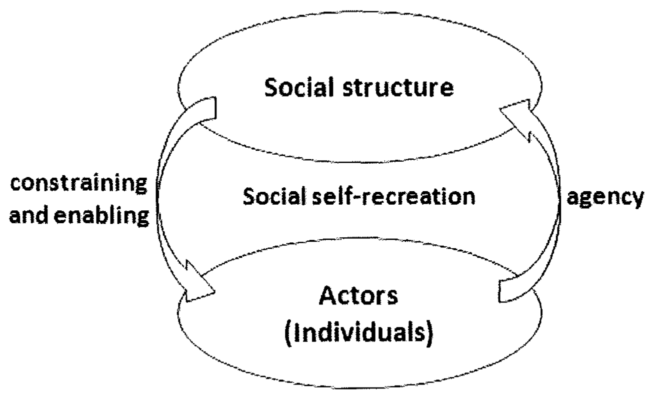
The agency and structure of a social system is what Giddens (1984, pp. 25-34) refers to as 'duality of structure'. The interaction produces different forms of institutions. For example, communication within the interactions of individuals produces significance to the system structure and significance enables and constrains communication (Giddens, 1984, pp. 28-30). Similar power within interactions between individuals produces dominance at the structure level and dominance enables or constrains power within interactions.

The structuration theory incorporates several similarities to social autopoiesis as it deals with continual, recursive, (re)production of social structure through time, which is clearly linked to the idea of self-producing systems, dichotomy of system and structure and relations of constitution-space, order-time and specification-paradigmatic (Mingers, 2004, pp. 406-408). Similarly, Hernes (2004a, pp. 38-39) draws a similar conclusion that the several different approaches of Luhmann (1995), Giddens (1984), Bhaskar (1978) and Latour (1999) deal with dichotomous relationships of actors and structure and subject and object, development of theories close to actions, rebuilding bridges between social and natural science, desire to explain continuity and reproduction in time-space and focus on the dynamics of evolving contexts for human actions and interactions.

These different approaches show close similarities to autopoiesis. However Mingers (2004) critically reflects and discusses two questions; the sense of production of components in social systems and secondly the challenge of operational closure. In Giddens approach a system incorporates three principles, namely, particular time-space location, a shared set of practices and awareness of shared identity to be considered as distinct social system (Mingers, 2004). The approach of Giddens (1984) and Bhaskar (1978) has been developed further by Fuchs (2002, 2003; 2008, pp. 11-120), who tries to solve some of the challenges involved with social autopoiesis.

**Fuchs's autopoietic social system theory**

Social autopoiesis by Fuchs (2002, 2003; 2008, pp. 11-120) and Fuchs & Hofkirchner (2009) incorporates the concept of the complex and emergence theory of self-organisation within the social self-reproduction of the system. It combines the structuration theory and self-organisation of social systems (Fuchs, 2003). This autopoietic social system theory is based on the approach that communication and social interaction do not constitute separate domains (Fuchs, 2003). The communication and social interactions are part of the structure that relates social groups and individuals and exists between individuals as a connecting mechanism (Fuchs, 2003). Fuchs (2003, p. 163) emphasised that this social structure can be conceived as a unity of social relationships that take place in and through interaction, communication and social forms such as rules and resources. This social self-recreation of the system.




**Dialectic of socials structure and actors (social autopoiesis) (Fuchs, 2002, p. 41; 2003, p. 145; Fuchs & Hofkirchner, 2009, p. 122; Hofkirchner, 1998)**

According to Fuchs (2003, p. 143) self-recreation refers to self-reproduction of the social system. In this process of social self-reproduction, global structures (macro level) emerge from local interactions (micro level) by circular causality (Fuchs, 2003, pp. 142-143). In this sense, the self-reference of the social system is based on the principle that society reproduces man as a social being and man produces society by socially coordinating human actions (Fuchs, 2003, p. 144). The individuals embedded in the social structure are constrained and enabled by this social structure as it influences an individual's actions and thinking (top-down process). On the other hand, through social interactions and communication new qualities and structures can emerge that cannot be reduced to the individual level (bottom-up process) (Fuchs, 2003, p. 144). Therefore, social structure appears through interaction and communication between individuals. This is the self-referencing processes of the social system, which allows the continuous reproduction of the social system and enables change of the system structure. Fuchs (2003, p. 144) stated that individuals enter social relationships that are partly independent of and partly dependent on self-determination of the individuals. Fuchs (2003, p. 144) emphasised that

> "the human being is a social, self-conscious, creative, reflective, cultural, symbols- and language-using, active natural, labouring, producing, objective, corporeal, living, real, sensuous, anticipating, visionary, imagining, designing, cooperative, wishful, hopeful being that makes its own history and can strive toward freedom and autonomy." (Fuchs, 2003, p. 144)

This means that individuals have some ability to change the situated social structure, for example in group situations, through their communications and social interactions, which can enable momentary systematic qualities (social spaces). Within these history-based and momentary establishments of social structures or systematic qualities (social spaces) new individual and group properties can emerge. Fuchs (2003, p. 145) renamed the self-reproduction to re-creation of social systems, because of the creative ability of human beings, who are able to anticipate possible future states of the world and have the ability to create something new. Creativity and knowledgeability of actors are the core of the process of recreation of the social system (Fuchs, 2003, p. 147). This creative dimension within the social system can be enabled or constrained within the recursive organisation by the system structure. In this sense, man designs society based on creativity as it allows going beyond facticity, creates visions of a desirable future (of society) and looks for a solution to existing (social) problems as discussed by Banathy (1996) cited in Fuchs (2003, p. 145).

The benefits for the investigation of creativity and innovation of Fuchs's (2003) theory is that the approach centres human actors and the role of humans as creative beings. Furthermore, the theory firstly incorporates the emergent complexity within the self-reproduction in which structure can emerge spontaneously. Secondly, it includes an approach of evolution, which is a vital concept within the theory of creativity and innovation. This autopoietic social system theory allows the investigation of creativity and innovation from an autopoietic social system perspective. The social autopoiesis theories provide the basis for a specific social system examination; the autopoietic organisation theory.

# Appendix C Questionnaire survey

DAIMLER NAPIER UNIVERSITY EDINBURGH SCOTLAND

## Organisational creativity survey

Sehr geehrte Damen und Herren,

Wir führen im Rahmen einer Doktorarbeit eine Umfrage durch. Dieses Forschungsprojekt untersucht die Prozesse in denen das Unternehmen Informationen und Wissen generiert und umsetzt, um Fehler zu beheben und innovative Ideen zu erzeugen.

Die Umfrage beinhaltet folgende Kategorien

- Information und explizites Wissen
- Vorheriges und stilles Wissen
- Vision & Führungsstil
- Unternehmenskultur & -klima
- Struktur & Arbeitsplatz
- Mittel (Ressourcen)
- Infrastruktur & Kommunikation
- Prozesse
- Lernen & Innovation

Diese Studie hat zum Ziel Mittel und Wege zur Unterstützung der Fehlerbehebung und der Innovativität im Unternehmen zu untersuchen.

Wir bedanken uns bei Ihnen für Ihre Zusammenarbeit.

Mit freundlichen Grüßen,

Hr. Inama Von Sternegg
ITF/SM

Hr. Schwill
GSP/TWM

Wir bitten Sie freundlichst den beiliegenden Fragebogen innerhalb der nächsten Wochen bis **11. April 2008** auszufüllen.

**Bitte schicken Sie den Fragebogen per Hauspost zurück an:**

**Jan Auernhammer**
**Doktorand**
**ITF / SM**
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**Epplestr. 225,**
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## Einführung

### Vertraulichkeit

**Vertraulichkeit und Anonymität wird grundsätzlich zugesichert.** Keiner außerhalb des PhD Research Teams (Supervision Team und PhD Student) der Napier University Edinburgh hat Zugang zu den Daten. Fragebogen und Auswertung werden mit der größten Sorgfalt und Genauigkeit gehandhabt.

An dieser Studie werden ca. 300 Teilnehmer aus den verschiedenen Bereichen des Unternehmens teilnehmen.

### Anweisung zum Fragebogen

Der Fragebogen wurde getestet und sollte **19 Minuten** Ihrer Zeit in Anspruch nehmen.

In diesem Fragebogen ist Ihre **individuelle Meinung** wichtig. **Alle Fragen beziehen sich auf Ihre Abteilung / Unternehmen.** Bitte nicht die Bedeutung der Aussage bewerten, sondern nur wie zutreffend dies in Ihrer Abteilung / Organisation ist.

Bitte lesen Sie jede Aussage durch. **Bestimmen Sie zu welchem Grad die Aussage auf Ihr/e Abteilung / Unternehmen zutrifft.** Bitte markieren Sie die Nummer in wie weit dies Ihrer Meinung nach auf Ihre Abteilung / Unternehmen zutrifft.

| - - | - | + | + + | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 0 |

**1** = Sie **stimmen nicht zu** das dies in Ihrer Abteilung / Unternehmen zutrifft
**2** = Es trifft in Ihrer Abteilung / Unternehmen **kaum zu**
**3** = Es trifft in Ihrer Abteilung / Unternehmen **größten Teils zu**
**4** = Sie **stimmen voll zu** das dies in Ihrer Abteilung / Unternehmen zutrifft.
**0** = Die Aussage ist nach ihrer Meinung **nicht anwendbar** auf Ihr/e Abteilung / Unternehmen.

| | **Beispiel** | - - | - | + | + + | |
|---|---|---|---|---|---|---|
| A | Wir erfassen kontinuierlich Informationen über unsere Produkte (z.B. Fehler in den Trucks, etc.) | 1 | X | 3 | 4 | 0 |
| B | Uns stehen kaum Informationen über unseren Service (z.B. Kundenbetreuung) zur Verfügung. | X | 2 | 3 | 4 | 0 |

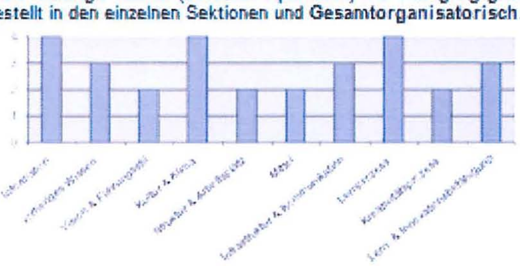
A = Wir erfassen regelmäßig sehr wenig Informationen über unsere Fahrzeuge. Wir könnten hier weit aus mehr Informationen sammeln (Dies könnte mit einer 2 bewertet werden, da potentiell viel mehr Informationen gesammelt werden könnten.)

B = Informationen über unsere Service wie z.B. der Erfolg unserer Kundenbetreuung steht unserer Abteilung im vollen Umfang zur Verfügung. (Dies könnte mit einer 1 bewertet werden, da Ihrer Abteilung im vollem Unfang Informationen zur Verfügung steht.)

### Auswertung der Fragen (vertraulich, anonym und NICHT bereichsvergleichend !!)

Sie werden die Übersicht der Umfrage zeitnah (innerhalb April 2008) zur Verfügung gestellt bekommen. **Diese Übersicht wird dargestellt in den einzelnen Sektionen und Gesamtorganisatorisch.**

Beispiel:
(Werte sind frei gewählt)



| Sektion A – Bereich, Sparte, Level & User (nicht in der Auswertung nur für die statistische Rechnung) | | |
|---|---|---|
| 1 | Bereich | o After Sales<br>o Qualität<br>o Produktion<br>o Entwicklung<br>o Vor-Entwicklung (Forschung)<br>o andere: ________________ |
| 2 | Spart | o PKW<br>o NFZ |
| 3 | Level | o Sachbearbeiter<br>o E4<br>o E3<br>o E2 oder höher |
| 4 | Wir sind User der Systeme | o zukünftig: AQUA (Advanced Quality Analysis)<br>o ZEUS<br>o QUIS VEGA<br>o XAS<br>o FFV-T<br>o FDOK |

| Sektion B – Information & explizites Wissen | | -- | - | + | ++ | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Wir erfassen kontinuierlich Informationen über unsere Produkte (z.B. „performance" der C-Klasse, Fehler in den Trucks, etc.) | 1 | 2 | 3 | 4 | 0 |
| 2 | Uns stehen keine Informationen über unseren Service (z.B. Kundenbetreuung) zur Verfügung. | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir erfassen kontinuierlich Informationen über unsere Prozesse (z.B. Produktionsprozesse, etc) | 1 | 2 | 3 | 4 | 0 |
| 4 | Informationen über unsere Kunden werden stetig erfasst. | 1 | 2 | 3 | 4 | 0 |
| 5 | Wir erfassen die neusten Innovationen (z.B. neue Technologien, Methoden, usw.) in unseren Geschäftsfeldern. | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir erfassen Informationen über die internen sozialen Bedingungen (z.B. Werte und Normen) in unserem Unternehmen. | 1 | 2 | 3 | 4 | 0 |
| 7 | In unserem Unternehmen werden innovative Ideen mehr durch die Analyse von Informationen gewonnen als durch Know-how unserer Mitarbeiter. | 1 | 2 | 3 | 4 | 0 |
| 8 | In unserem Unternehmen spielen Informationen eine bedeutende Rolle um wichtige Erkenntnisse über unsere Geschäftsbereiche zu schaffen. | 1 | 2 | 3 | 4 | 0 |
| 9 | Informationen (z.B. Berichte & Reports) bestärken uns in unseren Geschäftsentscheidungen. | 1 | 2 | 3 | 4 | 0 |
| 10 | Informationen helfen uns nicht Gespräche sachlicher zu führen. | 1 | 2 | 3 | 4 | 0 |
| 11 | „Does it make sense?" Diese Frage beantworten wir mit Informationen. | 1 | 2 | 3 | 4 | 0 |
| 12 | Informationen sind frei verfügbar in unserem Unternehmen | 1 | 2 | 3 | 4 | 0 |

| Sektion C – vorheriges & stilles Wissen | | -- | - | + | ++ | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Um unsere Informationen (z.B. Reports) interpretieren zu können ist fachspezifisches Wissen nötig. | 1 | 2 | 3 | 4 | 0 |
| 2 | Wir haben kein gemeinsames Grundverständnis wie unser Betrieb funktioniert. | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir müssen erst fachliche Kompetenz aufbauen bevor wir innovative Ideen in unserem Geschäftsfeld generieren können. | 1 | 2 | 3 | 4 | 0 |
| 4 | In unserem Unternehmen wird ausreichend Fortbildung angeboten um nötige Kenntnisse / Kompetenzen zu schaffen. | 1 | 2 | 3 | 4 | 0 |
| 5 | Wir verbessern kontinuierlich unsere Wissensbasis (z.B. neue Mitarbeiter, Binden von Experten an das Unternehmen). | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir überwachen unser Fachwissen in unserem Unternehmen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Unsere Mitarbeiter haben keine kommunikative Grundeinstellung. | 1 | 2 | 3 | 4 | 0 |
| 8 | Wir müssen unsere Informationen überdenken bevor wir eine Entscheidung treffen können. | 1 | 2 | 3 | 4 | 0 |
| 9 | In unserem Unternehmen ist bekannt in welcher Abteilung welches Wissen vorhanden ist. | 1 | 2 | 3 | 4 | 0 |

| Sektion D – Vision & Führungsstil | | -- | - | + | ++ | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Innovation spielt eine bedeutende Rolle in der Vision unseres Unternehmens. | 1 | 2 | 3 | 4 | 0 |
| 2 | In der Vision unseres Unternehmens spielt Wissen eine klare Rolle. | 1 | 2 | 3 | 4 | 0 |
| 3 | Unsere Unternehmensvision ist allen Mitgliedern kommuniziert worden. | 1 | 2 | 3 | 4 | 0 |
| 4 | Unsere Mitarbeiter im Unternehmen haben ein gemeinsames Ziel die sie gemeinsam erreichen wollen. | 1 | 2 | 3 | 4 | 0 |
| 5 | Operative Aufgaben und Zeit um über neuartige Lösungsansätze nachzudenken sind durch unsere Vorgesetzten in ein Gleichgewicht gebracht. | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir sind befähigt / ermächtigt innerhalb unserer Projekte eigene Ideen zu entwickeln. | 1 | 2 | 3 | 4 | 0 |
| 7 | Wir werden in unseren Arbeitsaufgaben durch unsere Vorgesetzten herausgefordert, um neue Ideen zu generieren. | 1 | 2 | 3 | 4 | 0 |
| 8 | Unsere Vorgesetzten nehmen das auf was wir ihnen mitteilen. | 1 | 2 | 3 | 4 | 0 |
| 9 | Die Werte in unserem Unternehmen werden von unseren Vorgesetzten gelebt. | 1 | 2 | 3 | 4 | 0 |
| 10 | Unsere Vorgesetzten sind offen für neue Geschäfts-möglichkeiten, auch wenn diese ungewöhnlich sind. | 1 | 2 | 3 | 4 | 0 |
| 11 | Fachkenntnis wird belohnt in unserer Karriereentwicklung. | 1 | 2 | 3 | 4 | 0 |

| | Sektion E – Unternehmenskultur & -klima | - - | - | + | + + | |
|---|---|---|---|---|---|---|
| 1 | Wir haben eine offene Kommunikation in unserem Unternehmen (z.B. Austausch von Fachwissen). | 1 | 2 | 3 | 4 | 0 |
| 2 | Unser Unternehmen ist offen für Veränderung. | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir sprechen unsere verborgene Meinung nur in informellen Gesprächen aus. | 1 | 2 | 3 | 4 | 0 |
| 4 | Unsere Mitarbeiter haben die Freiheit sich zu äußern. | 1 | 2 | 3 | 4 | 0 |
| 5 | Bei der Entwicklung von neuen Ideen / Konzepten werden Fehler bestraft. | 1 | 2 | 3 | 4 | 0 |
| 6 | In unserem Unternehmen werden Probleme ständig angesprochen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Neue Ideen werden nicht geschätzt in unserem Unternehmen. | 1 | 2 | 3 | 4 | 0 |
| 8 | Unsere Interaktionen im Unternehmen basieren auf Vertrauen. | 1 | 2 | 3 | 4 | 0 |
| 9 | Wir haben eine positive Atmosphäre in unserem Unternehmen. | 1 | 2 | 3 | 4 | 0 |
| 10 | Wir sind bereit ein Risiko einzugehen um eine neue Idee zu realisieren. | 1 | 2 | 3 | 4 | 0 |
| 11 | Unsere Mitarbeiter haben eine Eigenmotivation um Ideen umzusetzen. | 1 | 2 | 3 | 4 | 0 |
| 12 | Wir haben gemeinsame „Werte", die wir in unserem Unternehmen leben. | 1 | 2 | 3 | 4 | 0 |

| | Sektion F – Struktur & Arbeitsplatz | - - | - | + | + + | |
|---|---|---|---|---|---|---|
| 1 | Wir stellen unsere Projektteams mit vielen Fachleuten für einen hohen Austausch an Expertenwissen zusammen. | 1 | 2 | 3 | 4 | 0 |
| 2 | Die Unternehmensstruktur erlaubt es Entscheidungsträger leicht anzusprechen. | 1 | 2 | 3 | 4 | 0 |
| 3 | Die Unternehmensstruktur erlaubt den Aufbau von sozialen Netzwerken mit Mitarbeitern aus anderen Teilen unseres Unternehmens. | 1 | 2 | 3 | 4 | 0 |
| 4 | Bereichsgrenzen behindern die Kommunikation neuer Ideen. | 1 | 2 | 3 | 4 | 0 |
| 5 | Unsere Teams sind so organisiert, dass jedes Mitglied neues Fachwissen in seinem Teilgebiet lernt. | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir haben einen Ort (z.B. Bistro) an dem wir unsere Gedanken austauschen können. | 1 | 2 | 3 | 4 | 0 |
| 7 | An unserem Arbeitsplatz ist es möglich konzentriert über neue Lösungen nachzudenken. | 1 | 2 | 3 | 4 | 0 |
| 8 | Wir haben einen Raum in welchen wir gehen können um in Ruhe über neue Lösungen nachzudenken. | 1 | 2 | 3 | 4 | 0 |
| 9 | Unser Büro ist so gestaltet, dass es uns möglich ist kreativ zu arbeiten. | 1 | 2 | 3 | 4 | 0 |

| | Sektion G – Mittel | - - | - | + | + + | |
|---|---|---|---|---|---|---|
| 1 | Finanzielle Mittel stehen uns für Experimente zur Verfügung. | 1 | 2 | 3 | 4 | 0 |
| 2 | Finanzielle Mittel sind der Grund, dass ein Lösungskonzept / innovative Idee nicht umgesetzt wird. | 1 | 2 | 3 | 4 | 0 |
| 3 | In unserem Unternehmen sind ausreichend Fachleute vorhanden um neue Ideen zu entwickeln. | 1 | 2 | 3 | 4 | 0 |
| 4 | Wir haben genügend Zeit um neuartige Ideen zu entwickeln. | 1 | 2 | 3 | 4 | 0 |
| 5 | In unserem Unternehmen fehlen relevante Informationen um sachbezogenes Geschäftswissen zu schaffen | 1 | 2 | 3 | 4 | 0 |
| 6 | Uns ist es nicht möglich, alle vorhanden Informationen zu analysieren. | 1 | 2 | 3 | 4 | 0 |

| Sektion H – Infrastruktur & Kommunikation | | - - | - | + | + + | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Es ist uns leicht möglich Informationen über unsere Informationssysteme zu verteilen. | 1 | 2 | 3 | 4 | 0 |
| 2 | Informationssysteme werden genutzt um unsere Konzepte /Dokumentationen zu speichern (z.B. Produktkonzept, Prozessdesign) | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir haben ein Informationssystem, welches uns in der Vernetzung der Mitarbeiter unterstützt. | 1 | 2 | 3 | 4 | 0 |
| 4 | Es gibt Zentren in unserem Unternehmen, in welchen Wissen (z.B. Kernkompetenzen) festgehalten wird. | 1 | 2 | 3 | 4 | 0 |
| 5 | Meistens kommunizieren wir mit unseren Teammitgliedern über Email. | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir kommunizieren über Informationssysteme um die Möglichkeit zu besitzen, unsere Absprachen wieder hervorzuholen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Wir haben regelmäßig vorkommende formelle Meetings mit Mitarbeitern aus anderen Bereichen unseres Unternehmens. | 1 | 2 | 3 | 4 | 0 |
| 8 | Wir haben regelmäßig vorkommende informelle Gespräche mit Mitarbeitern aus anderen Bereichen unseres Unternehmens. | 1 | 2 | 3 | 4 | 0 |
| 9 | Wir haben Tools zur Analyse großer Mengen von Daten /Informationen. | 1 | 2 | 3 | 4 | 0 |
| 10 | Ideen werden im Meeting durch Schlagabtausch erörtert. | 1 | 2 | 3 | 4 | 0 |
| 11 | Ideen werden im Meeting durch Dialog erörtert. | 1 | 2 | 3 | 4 | 0 |
| 12 | Wir haben viele Vorschriften welche die interne Kommunikation betreffen. | 1 | 2 | 3 | 4 | 0 |

| Sektion I – Prozess (Lernen) | | - - | - | + | + + | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Wir haben klar definierte Prozesse, durch die unser Unternehmen sachbezogenes Wissen generiert. | 1 | 2 | 3 | 4 | 0 |
| 2 | Wir haben definierte Workflows um Fachwissen zu kommunizieren. | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir generieren Geschäftswissen indem wir Informationen aus IT-Systemen analysieren. | 1 | 2 | 3 | 4 | 0 |
| 4 | Unser Unternehmen schafft Wissen durch direkte Gespräche. | 1 | 2 | 3 | 4 | 0 |
| 5 | Unsere Mitarbeiter kommunizieren durch Informationssysteme. | 1 | 2 | 3 | 4 | 0 |
| 6 | Der Wissensaustausch mit anderen Teams geschieht in Besprechungen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Wir tauschen Ideen / Meinungen nur in informellen Gesprächen aus. | 1 | 2 | 3 | 4 | 0 |
| 8 | Businesss Know-how erwerben wir durch unsere Arbeit (on-the-job) | 1 | 2 | 3 | 4 | 0 |
| 9 | Know-how erwerben wir durch die Analyse von Informationen aus IT-Systemen. | 1 | 2 | 3 | 4 | 0 |
| 10 | Wir erwerben Know-how über Gespräche. | 1 | 2 | 3 | 4 | 0 |
| 11 | Wir kontrollieren mit einem Informationssystem, ob wir die Dinge richtig machen. | 1 | 2 | 3 | 4 | 0 |
| 12 | Wir kontrollieren mit einem Informationssystem, ob wir die richtigen Dinge machen. | 1 | 2 | 3 | 4 | 0 |
| 13 | Wir gehen regelmäßig an den „Ort des Geschehens" um Erfahrung zu sammeln | 1 | 2 | 3 | 4 | 0 |

| Sektion J – Prozess (Kreativität) | | - - | - | + | + + | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Wir haben definierte Prozesse zur Problemlösung. | 1 | 2 | 3 | 4 | 0 |
| 2 | Wir haben spezifische Methoden in unserem Unternehmen um auf neue Ideen zu kommen. | 1 | 2 | 3 | 4 | 0 |
| 3 | Wir schaffen neue Ideen durch Kombinieren von Fachwissen unterschiedlicher Disziplinen (z.B. Marketing, Entwicklung, etc.) | 1 | 2 | 3 | 4 | 0 |
| 4 | Wir entwerfen Szenarien um über die wirkungsvollsten Ideen nachzudenken. | 1 | 2 | 3 | 4 | 0 |
| 5 | Wir schaffen neue Ideen durch "trial and error" (ausprobieren, experimentieren). | 1 | 2 | 3 | 4 | 0 |
| 6 | Wir schaffen neue Ideen, indem wir an einem stillen Platz unser ruhendes inneres Wissen hervorkommen lassen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Wir schaffen neue Idee indem wir Problematiken neu angehen. (z.B. auf einem leeren Blatt neu beginnen). | 1 | 2 | 3 | 4 | 0 |
| 8 | In unserer Organisation schaffen wir neue Ideen indem wir unsere wahren Überzeugungen aussprechen. | 1 | 2 | 3 | 4 | 0 |
| 9 | Wir schaffen neue Lösung indem wir das Problem bewusst aus unterschiedlichen Perspektiven betrachten. | 1 | 2 | 3 | 4 | 0 |
| 10 | Wir haben einen definierten Prozess um über die Verwirklichung neuer Ideen zu entscheiden. | 1 | 2 | 3 | 4 | 0 |
| 11 | Die übergeordnete Entscheidung für die Umsetzung neuer Ideen liegt beim Controlling. | 1 | 2 | 3 | 4 | 0 |
| 12 | Die Erfordernisse unterschiedlicher Märkte (z.B. China, Afrika) werden bei der Entscheidung zur Realisierung einer Idee berücksichtigt. | 1 | 2 | 3 | 4 | 0 |

| Sektion K – Lern- & Innovationsbefähigung | | - - | - | + | + + | [illegible] |
|---|---|---|---|---|---|---|
| 1 | Wir erkennen potenzielle Verbesserungen in unserer Arbeit (z.B. Fehler im Produkt, Fehler im Prozess, etc.) | 1 | 2 | 3 | 4 | 0 |
| 2 | Unser Team erkennt ständig neue Geschäftsmöglichkeiten. (z.B. neue Entwicklungsmöglichkeiten, Kundennachfragen, etc.) | 1 | 2 | 3 | 4 | 0 |
| 3 | Unser Team verbessert kontinuierlich unsere Geschäftstätigkeit. (z.B. Produkt- , Service- , Prozessverbesserung) | 1 | 2 | 3 | 4 | 0 |
| 4 | Unser Team behebt fortlaufend Probleme. (z.B. das Beheben von Produkt-, Service- oder Prozessfehler) | 1 | 2 | 3 | 4 | 0 |
| 5 | Die Mitarbeiter unseres Teams schaffen Produkt- / Service-innovationen. | 1 | 2 | 3 | 4 | 0 |
| 6 | Die Mitarbeiter unseres Teams schaffen Innovationen in unseren Prozessen. | 1 | 2 | 3 | 4 | 0 |
| 7 | Innovationen werden durch unser Team häufig eingeführt. | 1 | 2 | 3 | 4 | 0 |
| 8 | Wir bringen mehr Innovationen heraus als unsere Wettbewerber | 1 | 2 | 3 | 4 | 0 |
| 9 | Wir verbessern ständig unsere Produkte / Service / Prozesse | 1 | 2 | 3 | 4 | 0 |
| 10 | Wir könnten innovativer sein. | 1 | 2 | 3 | 4 | 0 |
| 11 | Wir vergleichen (Benchmark) unsere Innovationen mit denen unserer Wettbewerber. | 1 | 2 | 3 | 4 | 0 |
| 12 | Unsere Abteilung gehört zu den Innovativsten. | 1 | 2 | 3 | 4 | 0 |
| 13 | Innovation wird definiert als neuartige Verbesserung unserer Produkte / Service / Prozesse | 1 | 2 | 3 | 4 | 0 |
| 14 | Produktinnovation / Serviceinnovation wird nur dann erreicht wenn der Kunde bereit ist einen höheren Preis zu zahlen | 1 | 2 | 3 | 4 | 0 |
| 15 | Prozessinnovation wird nur dann erreicht wenn die dadurch die Produktionskosten / Servicekosten gesenkt werden können. | 1 | 2 | 3 | 4 | 0 |
| 16 | Die Innovationsfähigkeit unseres Unternehmens ist der stärkste Wettbewerbsfaktor | 1 | 2 | 3 | 4 | 0 |

**Vielen Dank für Ihre Mithilfe.**

| Platz für weitere Kommentare über Ihr/e Abteilung / Unternehmen oder den Fragebogen. |
|---|
| |

# Appendix D List of interviews at Daimler AG

| No. | Date | Time | Department | recorded minutes |
|---|---|---|---|---|
| 1 | 13.10.2008 | 09.45 am | After Sales market management | 48.12 |
| 2 | 14.10.2008 | 11.30 am | Production & assembly | 27.00 |
| 3 | 16.10.2008 | 08.00 am | New product development testing | 33.32 |
| 4 | 16.10.2008 | 09.00 am | Production | 26.13 |
| 5 | 16.10.2008 | 01.00 pm | Product development | 33.34 |
| 6 | 16.10.2008 | 02.00 pm | Advanced engineering innovation management | 51.50 |
| 7 | 20.10.2008 | 03.00 pm | Production & assembly | 52.03 |
| 8 | 21.10.2008 | 11.00 am | Innovation workshop management | 49.34 |
| 9 | 22.10.2008 | 01.30 pm | Customer research centre | 14 |
| 10 | 22.10.2008 | 03.15 pm | Research department - Product innovation | 91.26 |
| 11 | 23.10.2008 | 09.00 am | Development & product testing | 22.37 |
| 12 | 23.10.2008 | 01.00 pm | After sales - New product development | 64.38 |
| 13 | 24.10.2008 | 08.00 am | Development | 55.05 |
| 14 | 24.10.2008 | 09.15 am | Strategic project – Product development | 30.01 |
| 15 | 24.10.2008 | 11.00 am | Quality management - New product development | PEN RECORDE D |
| 16 | 24.10.2008 | 01.00 pm | Test car assembly | 30.30 |
| 17 | 24.10.2008 | 03.30 pm | Innovation management (strategy) | 62.28 |
| 18 | 28.10.2008 | 02.00 pm | Business innovation | 43.49 |
| 19 | 29.10.2008 | 02.00 pm | Innovation management automotive | 27.43 |
| 20 | 29.10.2008 | 04.00 pm | Strategic project – Product development | 59.45 |
| 21 | 30.10.2008 | 08.30 am | Development | 70.33 |
| 22 | 30.10.2008 | 01.30 pm | Accounting - Innovation projects | 36.12 |
| 23 | 31.10.2008 | 02.00 pm | Product development (vehicle) | 83.49 |
| 24 | 03.11.2008 | 09.00 am | Testing and integration | 38.30 |

| No. | Date | Time | Department | recorded minutes |
|---|---|---|---|---|
| 25 | 04.11.2008 | 08.00 am | Product planning | 36.29 |
| 26 | 05.11.2008 | 09.15 am | Innovation management (strategy) | PEN RECORDE D |
| 27 | 05.11.2008 | 01.15 pm | Quality | 41.43 |
| 28 | 07.11.2008 | 10.15 am | Product design (innovation management) | 33.20 |
| 29 | 18.11.2008 | 03.00 pm | Product integration | 31.06 |
| 30 | 18.11.2008 | 04.00 pm | Product quality and audit | 34.46 |
| 31 | 20.11.2008 | 09.00 am | After sales product development | 22.05 |
| 32 | 20.11.2008 | 11.15 am | Innovation management (strategy) | PEN RECORDE D |
| 33 | 24.11.2008 | 10.15 am | Product development | 34.00 |
| 34 | 24.11.2008 | 11.15 am | Quality - Prevention and analysis | 07.15 |
| 35 | 24.11.2008 | 02.00 pm | Management product module quality | 28.29 |
| 36 | 25.11.2008 | 11.15 am | Product quality | 49.40 |
| 37 | 28.11.2008 | n.k. | Product design (innovation management) | 100.45 |
| 38 | 02.12.2008 | 10.05 am | Product development | 38.42 |
| 39 | 04.12.2008 | 10.35 am | Product development | 28.44 |
| 40 | 04.12.2008 | 03.00 pm | Marketing and customer orientated product development | 64.36 |
| 41 | 05.12.2008 | 10.35 am | Product design (innovation management) | 50.31 |
| 42 | 11.12.2008 | 11.00 am | IT management quality systems | 101.41 |
| 43 | 12.12.2008 | 11.30 am | After Sales | 12.24 |
| 44 | 12.12.2008 | 01.30 pm | Product design (innovation management) | 72.38 |
| 45 | 15.12.2008 | 02.15 pm | After Sales | 47.18 |
| 46 | 18.12.2008 | 11.30 am | Strategic project and product development | PEN RECORDE D |
| Total recorded minutes: 31 hours and 33 minutes (1893.27 minutes) Average recorded minutes per interview: 41.16 minutes | | | | |

# Appendix E List of presentations at Daimler AG

| No. | Date | Department |
|---|---|---|
| 1 | August 2010 | Mixed departments (main presentation) |
| 2 | October 2010 | Strategy and innovation department |
| 3 | October 2010 | Research department |
| 4 | October 2010 | Research department |
| 5 | October 2010 | Advanced development / innovation management |
| 6 | January 2011 | IT department |

# Appendix F Pearson's correlations matrix of the factors (statistical analysis)

| Pearson's correlations coefficient matrix | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **IP** | **IMP** | **B.I** | **B.II** | **C.I** | **D.I** | **D.II** | **E.I** | **E.II** | **F.I** | **F.II** | **G.I** | **G.II** | **H.I** | **I.I** | **I.II** | **I.III** | **J.I** |
| B.I | r | .410 | .471 | 1 | .571 | .413 | .422 | .314 | .465 | .358 | .198 | .433 | .273 | .260 | .223 | .379 | .201 | .055 | .472 |
| | *p* | .000 | .000 | | .000 | .000 | .000 | .000 | .000 | .000 | .011 | .000 | .001 | .001 | .004 | .000 | .013 | .506 | .000 |
| | N | 134 | 134 | 172 | 172 | 164 | 156 | 156 | 162 | 162 | 165 | 165 | 149 | 149 | 165 | 150 | 150 | 150 | 160 |
| B.II | r | .265 | .330 | .571 | 1 | .289 | .318 | .227 | .391 | .234 | .170 | .271 | .147 | .135 | .115 | .292 | .320 | .418 | .280 |
| | *p* | .002 | .000 | .000 | | .000 | .000 | .004 | .000 | .003 | .029 | .000 | .074 | .101 | .141 | .000 | .000 | .000 | .000 |
| | N | 134 | 134 | 172 | 172 | 164 | 156 | 156 | 162 | 162 | 165 | 165 | 149 | 149 | 165 | 150 | 150 | 150 | 160 |
| C.I | r | .309 | .329 | .413 | .289 | 1 | .455 | .292 | .511 | .383 | .212 | .388 | .318 | .319 | .131 | .433 | .140 | .143 | .414 |
| | *p* | .000 | .000 | .000 | .000 | | .000 | .000 | .000 | .000 | .004 | .000 | .000 | .000 | .076 | .000 | .075 | .068 | .000 |
| | N | 152 | 152 | 164 | 164 | 191 | 169 | 169 | 180 | 180 | 181 | 181 | 169 | 169 | 184 | 164 | 164 | 164 | 176 |
| D.I | r | .489 | .501 | .422 | .318 | .455 | 1 | .304 | .642 | .593 | .355 | .447 | .359 | .294 | .240 | .249 | .316 | .172 | .489 |
| | *p* | .000 | .000 | .000 | .000 | .000 | | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .002 | .002 | .000 | .034 | .000 |
| | N | 141 | 141 | 156 | 156 | 169 | 176 | 176 | 169 | 169 | 168 | 168 | 156 | 156 | 170 | 152 | 152 | 152 | 163 |
| D.II | r | .227 | .298 | .314 | .227 | .292 | .304 | 1 | .329 | .224 | .194 | .260 | .087 | .193 | .221 | .145 | .147 | .082 | .296 |
| | *p* | .007 | .000 | .000 | .004 | .000 | .000 | | .000 | .003 | .012 | .001 | .278 | .016 | .004 | .075 | .071 | .315 | .000 |
| | N | 141 | 141 | 156 | 156 | 169 | 176 | 176 | 169 | 169 | 168 | 168 | 156 | 156 | 170 | 152 | 152 | 152 | 163 |
| E.I | r | .480 | .510 | .465 | .391 | .511 | .642 | .329 | 1 | .784 | .338 | .567 | .451 | .438 | .271 | .261 | .380 | .159 | .475 |
| | *p* | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | .000 | .000 | .000 | .000 | .000 | .000 | .001 | .000 | .044 | .000 |
| | N | 149 | 149 | 162 | 162 | 180 | 169 | 169 | 189 | 189 | 178 | 178 | 166 | 166 | 183 | 161 | 161 | 161 | 175 |
| E.II | r | .334 | .431 | .358 | .234 | .383 | .593 | .224 | .784 | 1 | .351 | .510 | .379 | .409 | .222 | .180 | .283 | .062 | .370 |
| | *p* | .000 | .000 | .000 | .003 | .000 | .000 | .003 | .000 | | .000 | .000 | .000 | .000 | .003 | .023 | .000 | .434 | .000 |
| | N | 149 | 149 | 162 | 162 | 180 | 169 | 169 | 189 | 189 | 178 | 178 | 166 | 166 | 183 | 161 | 161 | 161 | 175 |
| F.I | r | .293 | .275 | .198 | .170 | .212 | .355 | .194 | .338 | .351 | 1 | .651 | .302 | .286 | .330 | .334 | .122 | .121 | .330 |
| | *p* | .000 | .001 | .011 | .029 | .004 | .000 | .012 | .000 | .000 | | .000 | .000 | .000 | .000 | .000 | .120 | .122 | .000 |
| | N | 151 | 151 | 165 | 165 | 181 | 168 | 168 | 178 | 178 | 190 | 190 | 167 | 167 | 185 | 164 | 164 | 164 | 176 |

| Pearson's correlations coefficient matrix | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **IP** | **IMP** | **B.I** | **B.II** | **C.I** | **D.I** | **D.II** | **E.I** | **E.II** | **F.I** | **F.II** | **G.I** | **G.II** | **H.I** | **I.I** | **I.II** | **I.III** | **J.I** |
| F.II | r | .376 | .363 | .433 | .271 | .388 | .447 | .260 | .567 | .510 | .651 | 1 | .355 | .337 | .402 | .413 | .243 | .160 | .495 |
| | *p* | .000 | .000 | .000 | .000 | .000 | .000 | .001 | .000 | .000 | .000 | | .000 | .000 | .000 | .000 | .002 | .041 | .000 |
| | N | 151 | 151 | 165 | 165 | 181 | 168 | 168 | 178 | 178 | 190 | 190 | 167 | 167 | 185 | 164 | 164 | 164 | 176 |
| G.I | r | .103 | .189 | .273 | .147 | .318 | .359 | .087 | .451 | .379 | .302 | .355 | 1 | .342 | .079 | .164 | .201 | .082 | .259 |
| | *p* | .217 | .023 | .001 | .074 | .000 | .000 | .278 | .000 | .000 | .000 | .000 | | .000 | .306 | .042 | .013 | .311 | .001 |
| | N | 144 | 144 | 149 | 149 | 169 | 156 | 156 | 166 | 166 | 167 | 167 | 174 | 174 | 168 | 154 | 154 | 154 | 164 |
| G.II | r | .210 | .199 | .260 | .135 | .319 | .294 | .193 | .438 | .409 | .286 | .337 | .342 | 1 | .106 | .198 | .132 | -.002 | .194 |
| | *p* | .011 | .017 | .001 | .101 | .000 | .000 | .016 | .000 | .000 | .000 | .000 | .000 | | .171 | .014 | .103 | .979 | .013 |
| | N | 144 | 144 | 149 | 149 | 169 | 156 | 156 | 166 | 166 | 167 | 167 | 174 | 174 | 168 | 154 | 154 | 154 | 164 |
| H.I | r | .212 | .199 | .223 | .115 | .131 | .240 | .221 | .271 | .222 | .330 | .402 | .079 | .106 | 1 | .291 | .085 | .109 | .204 |
| | *p* | .009 | .014 | .004 | .141 | .076 | .002 | .004 | .000 | .003 | .000 | .000 | .306 | .171 | | .000 | .276 | .164 | .006 |
| | N | 153 | 153 | 165 | 165 | 184 | 170 | 170 | 183 | 183 | 185 | 185 | 168 | 168 | 193 | 166 | 166 | 166 | 179 |
| I.I | r | .342 | .324 | .379 | .292 | .433 | .249 | .145 | .261 | .180 | .334 | .413 | .164 | .198 | .291 | 1 | .169 | .304 | .442 |
| | *p* | .000 | .000 | .000 | .000 | .000 | .002 | .075 | .001 | .023 | .000 | .000 | .042 | .014 | .000 | | .027 | .000 | .000 |
| | N | 141 | 141 | 150 | 150 | 164 | 152 | 152 | 161 | 161 | 164 | 164 | 154 | 154 | 166 | 171 | 171 | 171 | 167 |
| I.II | r | .364 | .327 | .201 | .320 | .140 | .316 | .147 | .380 | .283 | .122 | .243 | .201 | .132 | .085 | .169 | 1 | .255 | .320 |
| | *p* | .000 | .000 | .013 | .000 | .075 | .000 | .071 | .000 | .000 | .120 | .002 | .013 | .103 | .276 | .027 | | .001 | .000 |
| | N | 141 | 141 | 150 | 150 | 164 | 152 | 152 | 161 | 161 | 164 | 164 | 154 | 154 | 166 | 171 | 171 | 171 | 167 |
| I.III | r | .159 | .162 | .055 | .418 | .143 | .172 | .082 | .159 | .062 | .121 | .160 | .082 | -.002 | .109 | .304 | .255 | 1 | .231 |
| | *p* | .060 | .055 | .506 | .000 | .068 | .034 | .315 | .044 | .434 | .122 | .041 | .311 | .979 | .164 | .000 | .001 | | .003 |
| | N | 141 | 141 | 150 | 150 | 164 | 152 | 152 | 161 | 161 | 164 | 164 | 154 | 154 | 166 | 171 | 171 | 171 | 167 |
| J.I | r | .479 | .460 | .472 | .280 | .414 | .489 | .296 | .475 | .370 | .330 | .495 | .259 | .194 | .204 | .442 | .320 | .231 | 1 |
| | *p* | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .001 | .013 | .006 | .000 | .000 | .003 | |
| | N | 146 | 146 | 160 | 160 | 176 | 163 | 163 | 175 | 175 | 176 | 176 | 164 | 164 | 179 | 167 | 167 | 167 | 185 |

# Appendix G Qualitative data analysis: Example of pattern coding of focus groups and interviews data

### Step1 – Identification of key themes (pattern codes) from focus group data

Pattern code: **Freiraum**

Data segement from focus groups:

"What we as managers need to do are **providing our employees the Freiraum** and it does not matter if somebody has a coffee break at 9 or if he/she has a creative break at 11 in which he/she is walking outside around the building. These are the **Freiräume** (plural of Freiraum) in which **someone can become creative**."

Emerging constructs: Freiraum is a necessary condition for someone to become creative.

### Step 2 – Mapping key themes (pattern codes) with interview data

Pattern code: **Freiraum**

List of examples of data segments from interviews:

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 1 | 275-277 | Richtige Innovationen können eigentlich nur getrieben werden von erfahrenen Leuten die den nötigen Freiraum haben |
| 1 | 551-554 | Um Innovation zu fördern muss man Ruhe hereinbringen und nötigen Freiraum gewähren |
| 1 | 691-707 | Ideen entstehen ohne Strafandrohung und ohne hierarchische Tötung (Freiraum für Ideen) |
| 1 | 1029-1021 | Die Leute haben keine Zeit mehr an einem Thema dranzubleiben. Sie benötigen Freiräume. Man muss Freiräume für Innovationen schaffen. |
| 2 | 305-312 | Jeder Planer einmal im Jahr zum Montageeinsatz, dass er selbst etwas erlebt und auf eigene Ideen kommt. (Freiraum zur Erkundung) |
| 2 | 441-448 | Ich habe sieben Meister aus der Linie herausgenommen (Freiraum gegeben) und da kamen Superideen raus. |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 4 | 240-248 | Wichtig ist das man Freiraum geweht bei Fehlern und den Fehler des Anderen anzunehmen. |
| 6 | 15-19 | Innovation wird verhindert wenn man dem kreativ Schaffenden in einer Struktur zu wenig Raum gibt |
| 6 | 33-35 | Beispiel: 3M hat genügend Freiraum für Mitarbeiter um Sachen weiter zu entwickeln |
| 6 | 50-52 | Um eine Entscheidung zu treffen, ob ich eine Idee weitertreibe oder nicht, muss der Freiraum dazu da sein |
| 6 | 105-106 | Alte Strukturen hindern die Ideengeneration (Raum zur Schaffung neuer Strukturen ist nötig) |
| 6 | 139-142 | Die Bastler-Werkstatt (physikalischer Freiraum) ist ein Instrument um Ideen zu finden |
| 6 | 340-345 | Die Zukunft ist unbekannt, dadurch entsteht ein gedanklicher Freiraum durch den innovative Sprünge entstehen |
| 6 | 403-404 | Kreativität setzt eine entspannte Atmosphäre ohne normale Besprechungskultur voraus (sozialer Freiraum) |
| 6 | 417-419 | Wichtig ist die entspannte Atmosphäre für den Kreativitätsbereich (sozialer Freiraum) |
| 6 | 481-482 | Man weiss, dass man auch die blödeste Frage stellen kann (sozialer Freiraum) |
| 6 | 652-656 | Ein Wettbewerber stellt Leute mit tollen Ideen frei, um diese umzusetzen |
| 6 | 657-658 | Wir haben im Moment den Freiraum nicht, um solche Dinge wie ein Wettbewerber umzusetzen |
| 6 | 674-657 | Die gestalterische Freiheit, sich Ideen spielerisch zu nähern, kommt immer mehr in den Rückzug |
| 6 | 682-687 | Bei Google können Mitarbeiter frei Ideen generieren und werden freigestellt |
| 6 | 717-718 | Im Ideenhaus (Freiraum) konnte jeder eine Idee einwerfen |
| 6 | 768 | Man muss gedanklich frei sein etwas Neues zu machen (mentaler Freiraum) |
| 6 | 856-858 | Themenbezogene Budgets bringen finanziellen Freiraum (regulatorischer Freiraum) |
| 7 | 298-308 | Zu viel Verwaltung engt den Freiraum ein (regulatorischer Freiraum) |
| 8 | 79-80 | Wenn ich Neuerungen haben will, muss ich mich vom Vorhandenen erst einmal entfernen (Freiraum zur Erkundung neuer Ideen) |
| 8 | 175 | Jeder darf eine Idee aussprechen (sozialer Freiraum) |
| 8 | 216 | Wir sind ja quasi ein echt freier Raum (Inno-Werkstatt) |
| 8 | 532-535 | Sich selber mal eine Woche hinsetzen und darüber nachdenken (zeitlicher Freiraum) |
| 8 | 613 | Unbequeme Informationen dürfen nicht bestraft werden (sozialer Freiraum) |
| 8 | 861 | Eine gemeinsame Lösungsfindung mit ausreichend Diskussionsraum (mentaler und sozialer Freiraum) |
| 8 | 872 | An den relevanten Stellen muss man sich Zeit für die Projekte nehmen (regulatorischer Freiraum) |
| 8 | 899 | Man muss öfter mal auch ausgiebig sprechen |
| 8 | 928 | Bei den wichtigen und risikoreichen Themen, genau da muss ich mir Zeit nehmen |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 10 | 272-273 | Die Themenfelder kriegen ein eigenes Innovations-Budget (finanizeiller Freiraum) |
| 10 | 817-823 | Setzt euch zusammen, nehmt euch die Zeit und sagt, lasst uns doch bitte darüber nachdenken; und dann kommt ein ganzer Schwung an Ideen raus |
| 10 | 922-929 | Da muss man den Leuten aber vorher die halbe Stunde Ruhe gönnen. Dann fangen erst die kreativen Phasen an |
| 10 | 1540-1546 | Wenn der eine oder andere eine blöde Frage stellt, führt das unter Umständen wieder zum Nachdenken (erlauben von blöden Fragen – sozialler Freiraum) |
| 10 | 1916-1917 | Innovation ist nur in der Forschung und Vorentwicklung möglich, will da der Freiraum besteht |
| 12 | 807-817 | Immer wieder offen sein. Man muss immer die Augen offen halten zu diesen Themen (mentale Offenheit / Freiheit) |
| 12 | 930-934 | Wenn man mit unterschiedlichen Kulturen arbeitet, kommen neue Aspekte dazu (kultureller Freiraum) |
| 12 | 1012-1024 | Ein Mittelständler hat größere Entscheidungsfreiheit um innovativ zu sein (Raum zur Innovation) |
| 13 | 136-138 | Um Innovation schaffen zu wollen ,muss man sich ein Stück weit von dem was man hat freimachen können (mentaler Freiraum) |
| 13 | 767-772 | Man darf die innovationsfähigen Bereiche nicht zu stark anbinden |
| 13 | 802-803 | Wer ein echter Forscher ist, der möchte schon ein bisschen im freien Raum forschen |
| 13 | 920 | Also gibt es den Funktionsgruppen gewisse Freiheit, sich selber Ideen zu erarbeiten |
| 14 | 162-163 | Wenn man Angst hat, Rot zu melden, würde man bestimmte Dinge gar nicht kundtun |
| 14 | 171-178 | Es gehört Aufmerksamkeit dazu und eine gewisse Freiheit. Also möglichst wenig bevormunden |
| 14 | 274-277 | Es muss auch sein dass man die Freiheiten gibt innerhalb eine bestimmte Zeit |
| 14 | 349-352 | Die Möglichkeit, dass man sich irgendwo auf der grünen Wiese zusammensetzt und überlegt. Also raus aus dem Alltagsgeschäft |
| 14 | 361-364 | Ich muss mich einfach mal zurücknehmen und zurücklegen und überlegen |
| 14 | 475-476 | Eine gewisse Bestrafung von schlechten Nachrichten behindert die Kultur zur Innovation (verhindert Freiraum) |
| 14 | 504-508 | Freiheit Fehler zu machen ist notwendig (Freiraum zum ausprobieren) |
| 17 | 70-72 | Weg vom Alltag hin zu etwas Abgefahrenem, dass die Leute sich mal über andere Dinge Gedanken machen |
| 17 | 1049-1054 | Wir holen alle zusammen und dann wird gehirnt, was wollen wir zukünftig machen. Das ist Freiraum zur Innovation |
| 17 | 1068-1070 | Die Leute aus dem Alltagsleben rausreißen. |
| 17 | 1084-1088 | Dass man sich diesen Tag blockt und dann versucht mal abzutreiben, abzuschweben , schwelgen in den Gedanken |
| 17 | 1092 | Es heißt offene Community, wir lassen die Hierarchie weg, ja, wir versuchen es (struktureller Freiraum) |
| 17 | 1315-1323 | Wir diskutieren jetzt mal ganz offen, was sind eure Bedürfnisse und was könnt ihr dazu beitragen |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 17 | 1339-1340 | Offenheit und Transparenz ist ganz wichtig für den Freiraum |
| 17 | 1401-1402 | Also wir haben über alle Hierarchieebenen hinweg die Leute am Tisch und jeder hat eine Stimme (sozialer Freiraum) |
| 17 | 1622-1624 | Dieser Inno-Jam ist eine Ideenfindungs-Plattform. Ihr könnt da Ideen reinstellen (virtueller Freiraum) |
| 18 | 46 | Yes- there is no restriction. Everybody can enter any idea (virtueller Freiraum) |
| 18 | 207-208 | The system is open for everybody and everybody can look at all ideas and all ratings (virtueller Freiraum) |
| 18 | 254 | All your ideas will be heard |
| 18 | 287-288 | Everybody got the same voice and everybody got the same vote |
| 19 | 364-365 | Wir gucken. dass man die Leute zusammenbringt und dass man die in Ruhe lässt |
| 20 | 21-23 | Es ist schwierig aus Fehlern zu lernen , weil man keine machen darf (kein sozialer Freiraum zum Fehlermachen) |
| 20 | 77-80 | Es ist ein aggressiver Ton untereinander und Leute werden persönlich angegriffen verhindert den freien Austausch |
| 20 | 232-234 | Solange keine Fokussierung besteht, haben sie auch keine Kraft, wirklich innovativ zu sein (Raum zur Fokussierung auf innovative Themen) |
| 20 | 329-333 | Das haben wir vor 10 Jahren gemacht: wir haben uns Freiräume gegeben und gesagt: Hier spinne ich mal! |
| 20 | 340-345 | Es gab mal bei uns eine sehr freidenkende Forschung, und da sind dann richtig gute Ideen rausgekommen |
| 20 | 396-398 | Wenn es um Geld sparen geht, werden die Kreativen zuerst getötet (kein finanzieller Raum zum Erkunden und Ausprobieren) |
| 20 | 480 | Entwicklung braucht Zeit (zeitlicher Raum) |
| 20 | 601 | Man braucht einen gewissen Freiraum, das Ungewohnte denken zu dürfen |
| 20 | 605-606 | Ein Chef der sagt: Ich schaffe euch Freiraum trotz des Drucks. Dann haben sie Innovation |
| 20 | 610-612 | Ich habe einen Chef gehabt, der diesen Freiraum geschaffen hat. Ich gebe euch Geld und ihr macht jetzt mal |
| 20 | 619-621 | Wir waren innovativ weil wir einen Chef gehabt haben, der den Freiraum geschaffen hat |
| 20 | 936 | Wenn man Mitarbeiter den Freiraum zum erkunden und ausprobieren läßt kommen auch Innovationen heraus |
| 20 | 968-969 | Irgendwie Freiräume schaffen und den Leuten die Möglichkeiten geben auch an bestimmten Sachen Abstriche machen zu dürfen |
| 20 | 1082-1084 | Ich glaube auch da wieder, das A und O ist dies, Freiräume nachhaltig zu schaffen |
| 20 | 1095-1096 | Also man sollte vielleicht der Kreativität mal Raum verschaffen |
| 20 | 1106-1107 | Die dürfen sich wirklich einmal eine Woche zurückziehen und dürfen mal nachdenken |
| 20 | 1113 | Also Plätze und Freiräume schaffen für die Innovation |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 20 | 1133-1135 | Akzeptanz, dass sich Gedanken machen auch Arbeit ist |
| 20 | 1239 | Dreh – und Angelpunkt, dass wir hier mehr Freiräume schaffen |
| 20 | 1243-1267 | Freiräume schaffen, Risikobereitschaft, das sind die 2 Punkte, die die Innovation befähigen<br>Ein Chef der Freiräume schafft und sich vor die Leute stellt<br>Muss als Wert verankert werden: Risikobereitschaft und die Fähigkeit Freiräume zu schaffen<br>Da sind ein Haufen wilde Kerle dabei. Es liegt daran, dass er sagt: ich lasse euch mal machen.<br>Freiräume schaffen geht nur über Personen |
| 21 | 119-126 | Für Innovation muss man von den Gedanken her frei sein |
| 21 | 491-493 | Im Grunde sind wir die Roboter, die die Vorgaben 1:1 umsetzen sollen. Innovation ist gar nicht mehr gefragt. |
| 21 | 504-505 | Man kann nicht verlangen, dass Einer unter Befehlen kreativ ist. Ich muss auch da Gestaltungsfreiheit lassen. |
| 21 | 524-528 | Hier entscheide ich. Ich bin der Gott. Das bremst sofort Kreativität aus |
| 21 | 827 | Zeitweilige Hospitanzen. Lass den mal reingucken (Freiraum zum erkunden) |
| 21 | 1015 | Ich muss kreative Menschen von blödsinnigen Formalitäten entlasten |
| 23 | 310-392 | Mit allen Leuten geredet. Alles selbst organisiert. Mein Job war Hobby. Es war Kultur des Spaßes |
| 23 | 402-403 | Wenn man jetzt einen Vorschlag macht, wird die die ganze Selbstentscheidung genommen (kein Freiraum zur Selbstbestimmung) |
| 23 | 519-526 | Kreativität ist hier überall, allein man kann sich nicht entfalten weil kein Freiraum vorhanden ist |
| 23 | 534 | Wenn sie kein Geld in die Hand nehmen wollen, bleibt alles beim Alten. Nötig ist Risikobereitschaft und Schaffung von finanziellen Freiraum |
| 23 | 604-607 | Man muss ausprobieren, auch wenn es Geld kostet |
| 24 | 525-528 | Mehr Konsequenz in Qualität schafft Freiräume in den Abläufen, alte Standardprozesse können geändert werden. (Flexibilität in Prozessen) |
| 24 | 675-677 | Man muss immer wieder Events machen, um den informellen Austausch zu fördern |
| 25 | 36-39 | Man muss auch den Mut und den Raum haben, mal Dinge auszuprobieren |
| 25 | 189-190 | Da müssen sie sich nahezu wissenschaftlich mit den Themen auseinandersetzen und die Zeit dazu ist nicht mehr da |
| 25 | 217-219 | Wenig Menschen, überall Zeitdruck, die Ressource ist restriktiv, das Volumen ist mittlerweile verdreifacht (kein zeitlicheren Freiraum) |
| 25 | 229-231 | Um Risikobereitschaft zu erhöhen müsste man ein paar Leute, die den Kopf freihaben, für so etwas einsetzen (mentaler Freiraum) |
| 25 | 273 | Um innovativ in eine Entwicklung reinzugehen, braucht es Zeit |
| 28 | 112-114 | Inno-Werkstatt sollte den Ideengebern Bürokratie abnehmen. (Freiraum für Ideengeber) |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 28 | 519-533 | Sie haben sich in der Suche nach Innovation einschränken lassen (kein mentaler Freiraum) |
| 28 | 547-567 | Es passiert erst, wenn ihr euch mit der Thematik so weit auseinandersetzt, dass das Neue den Raum bekommt und wenn wir irgendwo was sehen, dann sehen wir auf einmal anders- und dann kommt die Intuition und neue Ideen |
| 28 | 664-666 | Kreativität hat jeder Mensch. Hierarchen aber sagen ‚was bist du von Beruf-Kaufmann- dann erzähle mir nichts von Technik (kein sozialler Freiraum) |
| 28 | 781-784 | Dass er mit der Idee weiter kommt, unabhängig davon , wo er herkommt, was für eine Hierarchie er hat |
| 29 | 188 | Es gibt in allen diesen Inno-teams Workshops welche den nötigen Freiraum geben |
| 29 | 325-326 | Wir machen diverse Hospitanzen für unsere Mitarbeiter (Freiraum zum erkunden) |
| 33 | 111-113 | Im Inhalt dieser Leitplanken muss sich der Mitarbeiter völlig frei bewegen können (Freiraum zur Ideengenerierung) |
| 33 | 127-128 | Diesen Freiraum, ich nenne mal kreativen Freiraum, mit anderen Leuten zu sprechen, über neue Sachen Gedanken zu machen |
| 33 | 274-290 | Wir suchen die Interessierten (motivierten) heraus und lassen sie woanders hospitieren (Freiraum zur Erkundung) das führt zu neuen Ideen |
| 33 | 296-302 | Ein Mitarbeiter der wirklich interessiert ist und dem ich sage: Mach mal fördert die Innovation (Freiraum geben) |
| 33 | 381 | Wenn sie denen den Freiraum lassen, dann brauchen sie keinen ‚Aufpasser‘, da die Mitarbeiter dann hoch motiviert sind |
| 36 | 186-187 | Nur dann, wenn man Ideen frei fließen lässt, kommt auch viel rüber (Freiraum zur offenen Kommunikation) |
| 36 | 310-311 | Wenn einer eine Idee bringt, die nicht so toll ist, mache ich den nicht nieder (sozialler Freiraum) |
| 36 | 611-614 | Leute ohne Angst vor Repressalien sind im Team offener Ideen auszusprechen |
| 37 | 1874-1875 | Apple hat einen Visionär, einen, von dem wir in Deutschland sagen würden, der gehört rausgeschmissen. Also eine Mentalität die wir nicht haben |
| 37 | 1907-1908 | Bereitschaft, extreme Visionen auszusprechen (sozialer Freiraum zur aussprach von extremen Visionen) |
| 37 | 1963-1965 | Sie brauchen die finanziellen Ressourcen, sie brauchen die persönlichen Ressourcen um Innovationen zu schaffen |
| 37 | 2433-2436 | Die Organisation gibt den Leuten Freiraum zur Ideengenerierung |
| 37 | 2555-2556 | Also die Bevollmächtigung, dann gerade dieser Freiraum um das umzusetzen |
| 37 | 2663 | Es geht nicht anders. Wenn sie Innovationen schaffen wollen, müssen sie frei sein (mentaler, sozialer und regluatorischer Freiraum) |
| 38 | 225-226 | Unsere Ingenieure haben viel zu wenig Zeit für die eigentliche Produktentwicklung (zeitlicher Freiraum) |
| 38 | 247 | Wir treffen uns auf einen Kaffee und diskutieren das, dabei entstehen gute Ideen (sozialer Freiraum) |

| Interview No | Line number | Short summary of segments from interview data (in German) |
|---|---|---|
| 38 | 306-307 | Man muss aufpassen, dass der Mitarbeiter nicht zu 100% ausgelastet ist. Dann funktioniert er nicht mehr und kann keine Innovationen schaffen. |
| 39 | 109-117 | Ein Chef hat die Mannschaft machen lassen (Freiraum geschaffen). Das war erfolgreich. |
| 39 | 168-169 | Es muss die Bereitschaft da sein, Fehler zu tolerieren |
| 39 | 247-250 | Mit doppelter Zeit würde man vielleicht eine Lösung bekommen (zeitlicher Freiraum) |
| 39 | 414 | Faktoren für Innovation: Zeit und Geld um neue Dinge auszuprobieren (Faktoren für Freiraum) |
| 40 | 1354 | Ja, man hat hier eine gewisse Freiheit in der Forschung |
| 41 | 115-129 | Für eine Innovation müssen sie komplett alle Kriterien über Bord werfen (keine Strukturen - Freiraum) |
| 41 | 180-181 | Da muss Freiraum geschaffen werden um Innovationen zu fördern |
| 42 | 174-184 | Einem Manager auf der unteren Ebene für sein Thema Entscheidungsfreiheiten geben, gewisse Freiheit, dass nicht alles zentralistisch regiert wird |
| 42 | 319-320 | Ein Forum schaffen, wo Ideen frei ausgetauscht werden können |
| 42 | 578 | Das fängt an mit Freiräumen, die man dem Einzelnen einräumen muss |
| 42 | 580 | Innovation findet statt, wenn man Zeit hat über etwas nachzudenken |
| 42 | 583 | Innovation wird möglich, weil der Einzelne diese Freiräume hat |
| 42 | 670-671 | Manchmal benötigt man ein Rausgehen aus der Projektorganisation- ein Zurückziehen um wirklich Innovatives zu machen (Freiraum) |
| 42 | 693-694 | Innovativ sein, weil du aufhörst in alten Bahnen zu denken |
| 42 | 742-743 | Jetzt denke ich mal in eine völlig andere Richtung und probiere etwas völlig Neues (mentaler Freiraum) |
| 42 | 817-819 | Der bekommt jetzt 100% frei und darf sich Gedanken machen |
| 42 | 829-830 | Innovation ist auch Arbeit, und muss dafür freigestellt werden |
| 42 | 856-857 | Bei Innovationen wurde diese Kreativität, dieser Freiraum geschaffen |
| 42 | 1035-1036 | Man ist innovativer mit offener Kommunikation, Wertschätzung, Vertrauen. Dies erlaubt den Raum zur Innovation |
| 43 | 53-54 | Wir müssen mit Innovationen schnell machen, ohne Kosten, aber eigentlich brauchen wir mehr Zeit (zeitlicher Freiraum) |
| 43 | 121-122 | Wir müssen einen Schritt zurücktreten und sagen, wir machen es einmal ganz anders (raus aus Routine in den Freiraum) |
| 44 | 1504-1505 | Gespräche am Kaffeetisch und im Flur, dabei entstehen neue Ideen (physicalischer Freiraum) |
| 45 | 688-689 | Die Bereitschaft zu Ideen muss auch vom Management gelebt und gewährleistet werden (Freiraum einräumen) |
| 45 | 844-850 | Eine Plattform / Freiraum für kreative, die über den Tellerrand hinausgucken (Freiraum zum erkunden von neuen Ideen) |

# Appendix H Implications of the 'hard' system model

The 'hard' system model has several implications for the organisational innovation capability. The system model allows, firstly, thinking about the influences of an organisational action (for example a corporate program) that aims at one particular factor, can influence additional factors. For example, change in organisational structure can lead to a change in behaviour, which than lead to an adaptation of a different leadership style. This needs to be taken into account when implementing organisation-wide initiatives, programs and structures.

Secondly, many factors do not necessarily have a direct impact on innovation, but may influence factors, which are essential for innovation. Therefore, change in one factor, which has no direct influence on the innovation performance, but impacts a factor of direct influence can ultimately reduce the organisational innovation capability. For example, change in the organisational budget system can change behaviour and ultimately the innovation performance.

Thirdly, the model emphasises that strategic innovation management requires holistic or system thinking. For example, one department makes an organisation-wide initiative, which makes improvements in their function. This initiative can influence several other functions and results overall in the reduction of the organisational capability. Consequently, an organisation requires collective co-creation and system thinking to prevent dynamics, which result in the decrease of the organisational innovation capability.

Fourthly, innovation strategies require producing system dynamics that establish conditions that increase the innovation performance. The organisational design (regulatory space) highly interacts with the organisational culture (social space). Strategies that change organisational structures, processes and regulations need to be linked to the social system. Without this linking, the results can be, for example, the reduction of motivation (social system) and eventually the decrease of the innovation performance. Regulatory strategies disconnected from the mental and social space can therefore result in opposite outcome as anticipated.

Fifthly, many of the factors of the 'hard' system model, for example, organisational behaviour, cannot be managed directly. Therefore, the system structure of 'the organisation' is not a result of strategies, but of the daily interaction of individuals that produce the structure of the organisation as pointed out in section 3.4.3 (page 86). Consequently, the context of 'the organisation', its complex interrelations (system), its relationship with the innovation performance and the effects of a 'strategic initiative' needs to be understood and practiced throughout the organisation. As a result the system itself produces an environment in which context (for example behaviour, structure of teams, processes, and knowledge creation) positively related to innovation can emerge. This produces ultimately an organisation with a high organisational innovation capability.

# Appendix I Implications of the soft system model

The 'soft' system model has several implications. Firstly, the model solves the innovators' dilemma of either exploitation or exploration as it allows teams to produce dynamically and self-organised spaces of both exploitation and exploration. Individuals and teams can decide when to exploit (produce the space of thick in the action) or explore (produce the space of Freiraum). This requires a certain level of redundancy (Freiraum) within the system. The exploration can be supported through initiatives such as open innovation and experiencing at the place outside the organisation (exogenous knowledge creation). This requires the individuals to decide to use the Freiraum (redundancy) to create this knowledge outside the organisation.

Secondly, organisations face the problem of building an 'innovation culture' through global initiatives. This is not possible because standardisation is counterproductive to creativity. Not the organisation is required to be creative, but rather individuals and teams are required to be creative within temporal produced spaces. This allows different individuals and teams to produce different spaces at the same time. For example, one team needs to produce Freiraum to solve a problem, while another team executes an action plan within the space of the thick of the action. The organisation (culture, design and management) is required to allow different spaces to emerge, through a certain level of redundancy (organisational Freiraum).

Thirdly, the production of different spaces requires situated management, leadership and organisation for creativity to emerge in momentary events. Leaders are required to manage situations of momentary events within individuals' interaction (momentary sense-making, organising, managing) rather than providing global initiatives (standardised and global strategies and management initiatives) to facilitate creativity. The global strategies should focus at initiatives that allow individuals and teams to produce several different spaces dynamically and self-organised through a certain level of freedom or redundancy (Freiraum).

Fourthly, the model is based on self-organised (self-produced) dynamics, which dynamically produce spaces in which creativity can emerge. Freiraum avoids standardisation as individuals can self-determine their actions and therefore produce the necessary actions and interaction to explore opportunities and produce novelty. This allows new structures, actions and ideas to dynamically to emerge.

Lastly, the production of creative ideas and concepts requires Freiraum to produce novelty and change. At the same time, thick in the action (knowledge creation at the place) is required for the idea to be valuable, appropriate and/or useful. By its nature novelty includes uncertainty and therefore the judgment of a novel idea is difficult and value cannot be identified without prototyping the new ideas. This prototyping includes exploring feasibility and viability of the novel idea to develop it into a novel and valuable concept, action plan, prototype (evolution of ideas). As resources are limited, the highest prioritised ideas (prioritised by the team or in online idea communities by the individuals of the organisation) should be supported and prototyped by bringing it back into the thick of the action. This includes intrinsic motivation, openness to change, risk-taking and dealing positively from mistakes and learning from them as fast as possible by the teams involved.