

Cranfield University

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**Towards a Mid-Range Theory of Method Selection for  
Innovation Pre-project Activities.**

School of Industrial Manufacturing Science  
Enterprise Integration

PhD Thesis





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Innovation Pre-project Activities.**

Supervisor: Dr Fiona Lettice  
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## Abstract

There is a large variety of approaches that describe the pre-project innovation phase as the cradle of successful innovation activities, and thus as an important factor to reach the objective of organisational growth and competitive advantage. However, theoretical contributions to date mainly address this phase either from a strategic or from an organisational perspective. On a conceptual level, the developed methods are either specific to an organisational situation, or too general to be applied in a specific problem situation. In consequence, there is a missing link between strategy, organisation and concept development in theory about the early stage innovation activities. Thus, the innovation pre-project phase is not researched in an holistic way, which prevents a structured accumulation of knowledge in the research field.

In this thesis, this gap is being bridged by developing a mid-range theory about the appropriate selection of methods in different, generic organisational situations. The theoretical framework consists of four theoretically derived situations and a set of generic activities that are conducted in pre-project innovation phases. The framework builds upon the research fields of decision-making and problem-solving theory, strategy development, and the contingency view. By combining these perspectives, the strategic problem of generating profit can be solved by the two second order problems of organising and conceiving new products or services.

Profit can be generated by solving customers' problems, and this can be pursued by organising this process together with external collaboration partners in a value chain or network. In consequence, the degree of customer problem-solution and the degree of external collaboration are identified as the two dominant factors to describe the strategic innovation problem, and thus the innovation problem solving focus. As a result, on the basis of customer needs theory and transaction cost theory, the four generic situations are derived, and operationalised together with pre-project activities and the concept of methods.

On the basis of the operationalised concepts, propositions about adequate method selection were derived, and further evaluated and illustrated by case study research. The thesis ends with the development of hypotheses about the framework and the value of appropriate method selection. On the basis of these hypotheses, requirements for appropriate method selection in different organisational situations were developed.

The central contribution to knowledge provided by this research is the approach to the innovation pre-project phase on the conceptual level in contrast to the existing approaches on an organisational or strategic level. By the development and application of the theoretical framework, research about methods can be conducted on a more general level and then be refined and tailored to specific organisational situations. Redundancies and contradictions from comparison of research conducted for specific situations can be explained, and further accumulation of knowledge in the field of pre-project innovation activities is enabled. As a result, the developed mid-range theory allows a more comprehensive and structured approach to evaluate and understand the innovation pre-project phase compared to existing research in this topic.

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## About the Author

Torsten studied Business Administration at the University of Munich, majoring in Information and Communication Studies, Technology and Innovation Management, and Organisational Psychology. In 1999, he started to work as Assistant to the Managing Director of a medium sized metal processing company, Mevaco. In 2001, he started to work as a freelance consultant for Vodafone Group R&D, FutureCamp GmbH, Fraunhofer IAO, and for several other organisations. In the course of his freelance activities, he participated in several funded research projects, like UNIKAT (identifying and tapping potentials from within the organisation), CIKM (creation of innovation through knowledge management) and ProSecCo (Product-Service Co-Design). Today, he works as a project manager for Lischke Consulting, an implementation oriented consultancy, where he is responsible for the new product development and innovation management practice.

## Publications

Hipp, Christiane; Herzberg, Torsten (2003) *Mit strukturierter Kommunikation die Potenziale möglicher Zukunftsfelder erkennen und erschließen. Visionen der Vodafone Pilotentwicklung*. In: Kohlgrüber, Michael; Schnauffer, Hans-Georg; Jaeger, Dorit (eds.): *Das einzigartige Unternehmen. Mit dem Potenzials Scanner strategische Wettbewerbsvorteile entdecken*. Berlin, Springer pp 80-94.

Thomond, P.; Herzberg, T.; Lettice, F. (2003) *Disruptive Innovation: Removing the Innovators' Dilemma*. Knowledge into Practice - British Academy of Management Annual Conference, Harrogate, UK, September.

Herzberg, T.; Lettice, F.; Thomond, P. (2004) *Methods for Pre-Project Innovation Processes - Developing Propositions for their Selection in Different Company Situations*. Managing Futures - British Academy of Management Annual Conference, St Andrews, UK, September.

Thomond, P.; Lettice, F.; Herzberg, T. (2004) *Disruptive Innovation: Enabling Practitioners to Tackle the "Innovators Dilemma" With Graphical Techniques*. In the proceeding of The 11th International Product Development Management Conference - Design to Deliver: The Challenge of International Integration, Dublin, Ireland, June 1181- 1195.

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## 1 Introduction and Proceeding.

*Chapter aims: In this chapter, I will introduce the topic of innovation, and I will illustrate the importance of the pre-project phase. On this basis, I will describe the research problem, introduce the research objectives and outline the research approach and thesis structure.*

In the first step, a general introduction will describe the importance of innovation as a source for competitive advantage. Then, the term innovation will be described in more detail, and several approaches to its definition will be introduced. A closer look at the phenomenon will show that innovation processes can be interpreted as organisational problem solving processes. It will also be shown that especially the pre-project phase is not sufficiently researched from a conceptual perspective, and a framework that integrates strategy and organisational measures with concept development is missing. On the basis of this research gap, objectives and the research approach and structure for this thesis will be introduced.

## 1.1 Introduction.

### **Innovation is a source of competitive advantage.**

The importance of innovation as a source of future competitive advantage has probably been known, although probably not recognised explicitly, since the first competitive activities of economic actors took place.

The high and long-lasting interest in the topic can be seen by the fact that there is a vast body of literature about it, dating back to the 1960's (Burns/Stalker, 1961) and, on an economic level, even back to the beginning of the last century (Schumpeter, 1912). In the context of competitive strategy, innovation can be seen as an important factor to increase competitive strength (Tidd et al, 2005). As a result, experts see innovation as a chance to generate new income and profits (Trott, 1998), and as a consequence the creation of new employment opportunities (Solow, 1956).

Therefore, unsurprisingly there are several institutions supporting and facilitating innovation. On an economic, governmental and regional level, there are the European Commission, national ministries for economy and employment and regional agencies supporting the growth and success of established and start-up companies, because it is assumed that innovation may help to lower unemployment rates and raise national income.<sup>1</sup>

### **Innovation consists of invention and exploitation.**

The term of innovation itself is used in very different ways. There is no common exact understanding about the term. Depending on the context of research, it is defined as an economically exploited invention (Tidd et al, 2005), an idea successfully translated into the market (Twiss, 1974), or as an integrated process of idea conception, invention and market development (Myers/Marquis, 1969). Van de Ven (1986) defines innovation as a novelty that can also consist of a recombination of existing solutions. Most of the common research focuses on innovation in the context of technology and invention. More recent research focuses also on innovation of services without technological components (Miles, 1996, Hipp, 2000; Tether et al, 2000).

To conclude, a pragmatic and illustrative definition describes the phenomenon as consisting of the two components of invention and exploitation, meaning the conception and realisation of a new product, service or process in order to raise the economic benefit of an innovator.

### **Innovation management can be interpreted as an organisational problem solving process.**

In this research, the process of innovating is considered to be a problem-solving process (see also Gerpott, 1999). In this context for organisations, the problem of innovating can be divided into the two phases of conception and realisation. While the realisation normally is pursued by an innovation project, the conception phase is a more unstructured phase prior to a project. In the latter, the strategic approach and the concept of the innovation are conceived. This phase is crucial and provides the cradle of future success for innovation projects and therefore for the future competitive success of the innovating organisation (Goffin/Mitchell, 2005). This early stage of innovation projects, the pre-project phase, is the central focus of this research project.

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<sup>1</sup> see also <http://www.cordis.lu>



On a company level, depending on organisational size, there are several kinds of organisational departments that might be responsible for innovation activities, like research and development, new business development or strategic planning divisions.

Understanding that innovation is an important topic for a company's strategy does not necessarily mean that it is trivial to perform (Drucker, 1998; Goffin/Mitchell, 2005). In the later phases of the innovation process, project planning and management and engineering skills are necessary (Pleschak/Sabisch, 1996). However, in the early phase of innovation there are several factors making the task an ambiguous challenge.

### **The uncertainty of the pre-project innovation phase presents a challenge.**

The early phase of innovation is defined as the process starting with a first, deliberate activity towards developing a certain innovation concept, ending at the point of the decision as to whether the concept is going to be realised or not (Cooper, 1992; Goffin et al, 1999; Khurana/Rosenthal, 1997). This phase can be seen as a decision process (Gerpott, 1999; Harrison, 1995). In this special case, the decision process ends in an innovation project. Therefore, this early-stage innovation phase will also be called the pre-project phase synonymously.

In this phase, it has to be clear which customer need or problem is going to be solved by the innovation, making it necessary that customers, or at least the innovator, know about customers' needs. Often, and especially in the situation of a radical innovation and long-term innovation planning, the customers' needs are not clear or may even not yet exist (von Hippel, 1989). Further, from a technological point of view, the product, service or process might rely on a technology or principle that does not yet exist or there may be several competing technologies making it hard to decide which might be the most promising way to solve the customers' problems or to satisfy their needs in the future (Foster, 1986; Christensen, 1997). In addition to the customer needs and technological uncertainties, it might not be clear how the economic and regulatory environment evolves or how partners in the value chain are attracted or forced to be involved in the realisation of the new concept. Therefore it is highly ambiguous as to whether it will be possible to set up a new business that has the potential to be economically attractive and sustainable.

When searching for future products, services or processes, there is naturally a time lag between conception and exploitation. In this period, the environment related to the innovation might change, which aggravates the problem of defining a good solution for sustainable future profit. These interdependencies between the factors make the early phase of innovation processes a complex problem to solve in an ambiguous environment: and so have often been called the fuzzy front-end of innovation (Khurana/Rosenthal, 1997; Sheth/Ram, 1987)

An organisational strategy sets the direction for how organisations can generate and sustain profits in the market environment (Mintzberg et al, 1998). The aforementioned uncertainties lead to the fact that an organisation's strategy can only act as a framework for innovation activities, but not as a detailed plan to be realised in terms of a sequential concept (Khurana/Rosenthal, 1998; Cooper, 1993). Thus, developing future business is directed by the organisational strategy, but is also about identifying opportunities for future activities with strategic impact. This fact makes innovation strategy an integral part of the overall business strategy (Tidd et al, 2005).

### **The conceptual perspective on pre-project innovation activities is not sufficiently researched.**

The number of approaches that organisations can choose in order to innovate is almost uncountable, although not every approach may promise a successful realisation. Considering each approach as an individual problem that could be solved would mean that each of these problem-solving approaches would require specific and individual methods, if method requirements are individual to a

## Introduction and Proceeding.

problem. In innovation research, there are several different approaches to describe and analyse differences in innovation processes and their outcomes. Examples are distinctions between the degree of innovativeness (Danneels/Kleinschmidt, 2001; Garcia/Calantone, 2001), sectoral patterns, (Pavitt, 1984), the maturity of products and technologies (Foster, 1986) and many more contingencies, that help organisations to analyse their situation and therefore make decisions about the design of their processes.

Depending on the focus defining the perspective to the innovation challenge, there are different tools, methods, proceedings and recommendations for innovators about how to decide or how to pursue the task. As the methods and tools are based on different levels of analysis, it is likely that different methods even lead to contradictory results and recommendations if these are not applied in one single context.

As a result, there is a vast body of literature offering a wide range of methods to be applied in the early innovation phase, most of them being developed from practice. A practical problem is highly specific, and therefore methods are also very specific to certain problem types. In consequence, the offer for methods is very high. For organisations this ends in the problem of identifying, adopting and applying appropriate methods for their specific situation out of a vast amount of possible methods. When comparing method recommendations for organisations, they are not entirely free of contradiction among each other, nor is it entirely clear of how to realise the results of strategic analysis and conception in a certain organisational situation.<sup>2</sup> To conclude, existing research about innovation methods lacks a structured frame and common definitions which leads to the problem that research results cannot be compared to each other and accumulation of knowledge is prevented.

For researchers, this unstructured context for evaluation raises the problem of understanding the pre-project phase in an holistic way. Therefore, research on the fuzzy front-end of innovation is still very vague and abstract, and recommendations can only be made on the level of creating an environment for innovation conception but not on explaining how to actually develop an innovation concept (see chapter two for an extensive discussion). Existing research focuses either on more organisational (Khurana/Rosenthal, 1998; Cooper, 1993) or on more strategic questions (Foster, 1986; Christensen, 1997). The question of how to approach the problem of innovating from a problem-solving perspective is not researched sufficiently yet.

In the context of this research, this perspective on the generation of concepts for innovation will be called the conceptual perspective. On this conceptual level, the question arises of whether experience with methods and innovation problem-solving can be transferred from one organisational situation to another.

**The aim of the research will be to find out whether there are patterns of conceptual innovation problem-solving in different situations for pre-project processes in order to enable future research to better describe, understand, predict and form the design of pre-project innovation activities.**

Therefore, the practical challenge of this research area is to enable organisations to systematically select methods for their pre-project innovation activities in order to design their pre-project innovation phase on a conceptual level.

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<sup>2</sup> To illustrate an example: Porter's (1985) framework would suggest to follow a cost leadership strategy in a mature industry, while Foster's (1986) s-curve concept or Christensen's (1997) concept of disruptive technologies would suggest to make a different decision towards technology development. Of course, both types of recommendations could be followed at a time. However, this example illustrates a potential contradiction. A framework, that helps to analyse an organisational situation as a whole, that also suggests concrete approaches for an innovation concept, could provide a solution for these kind of contradictions.

Problem solving is a cognitive process (Mintzberg et al, 1998; Harrison, 1995). This implies that information collection, processing and communication are main activities in pre-project innovation problem-solving activities. As a result, methods to support this process will be in the focus of this research. In chapter 4, the concept of methods will be derived and defined in more detail as it is necessary at this point of the research.

## 1.2 Research Question and Objectives.

Summarising the section above, the practical problem behind this research is to enable organisations to select appropriate methods for their early-stage innovation phase. From a research perspective, this project aims to understand the requirements for methods in early-stage innovation activities, and thus to develop beyond general recommendations about strategic or organisational measures. On the basis of these requirements, theory of innovation pre-project activities can be structured and further accumulation of knowledge is supported.

The resulting central research question is:

***What are the requirements for the selection of methods in pre-project innovation activities in different organisational situations?***

This central question guides through the whole thesis. It will be reflected and refined at the end of the subsequent chapters. Based on this central research question, three major research objectives arise, in order to **develop, evaluate and apply** theory about selection of methods in pre-project innovation processes in different organisational situations:

- Objective 1:** A conceptual (or concept oriented) perspective on pre-project innovation activities does not yet exist. Therefore, **a theoretical framework for the conceptual analysis and description of the fuzzy front-end of innovation processes** will be developed.
- Objective 2:** The theoretical framework, in concrete the concepts of **generic situations for innovation problems, activities in pre-project processes, and methods for information collection, processing and communication** will be derived and operationalised, and propositions for their selection will be derived.
- Objective 3:** The **framework and propositions will be validated** by case study research, in order to enable **the development of hypotheses about the developed theory and to apply the theory by deriving requirements** for method selection.

### Consequences for and contribution to existing research.

As already stated above, it cannot be the aim for this research to derive specific methods for specific innovation problems. However, this research does aim to solve a research problem that arises from the broadness and complexity of the research topic by delivering a framework and common context for the research of the early-stage innovation phase. The conceptual perspective will allow a link to be made between the two classic strategy-related and organisation-related research approaches. This delivers three key contributions and benefits to the current state of innovation research:

- **The conceptual perspective** on pre-project activities allows the process to be understood from a problem-solving perspective. This implies an analytic description of the task and therefore the possibility to give it a more detailed and task-related structure. From a

research perspective, this allows each activity to be analysed and related to the context of pre-project innovation activities, and in consequence to organisational and strategic means. A practical implication is that the task activities can be divided and better co-ordinated in team structures, and that activities can be better aligned with organisational strategy.

- Based on the conceptual perspective, **a structure and clear understanding of innovation pre-project activities** is going to be developed. This implies a non-sequential view of the pre-project phase and therefore the possibility to analyse the pre-project process from an activity-based point of view. From a research perspective, this allows requirements to be defined for methods derived and defined by the tasks themselves. From a practical perspective, this enables the implementation of pre-project processes in organisations.
- Based on the theoretical framework of the conceptual perspective, methods requirements for **organisational situations** are derived. This contingency-view perspective allows the requirements for methods to be analysed independently from existing concepts like industry related or organisational structure related requirements. The concept of a situation for pre-project innovation activities allows the activities to be analysed from a result or solution-type perspective. From a research point of view, the objectives and activities in pre-project processes can be analysed in more detail, with reduced redundancies and contradictions. For researchers this implies a more differentiated way to analyse pre-project activity processes. From a practical perspective, this implies that one organisation can be in several situations at a time and therefore this can help them to organise their pre-project activities according to each specific situation.
- The **operationalisation of the key concepts** of organisational situations, pre-project activities and methods, and further the development of propositions and hypotheses about the theory enables future activities on a quantitative basis. From a research perspective, this implies that the theory can be evaluated, tested and further developed. From a practical perspective, concrete measures can be derived to adapt to a specific organisational situation.

The key effect of this research will be:

**To enable future research to better describe, understand, predict and form the design of pre-project innovation activities by developing patterns of conceptual innovation problem-solving in different organisational situations. This will be pursued by providing a new access to the topic that allows a differentiated, generic view on organisational situations.**

Research to date is limited to organisational or industry related distinctions of organisational situations, which leads to contradictory recommendations. By approaching the research object in the conceptual level, the actual problem solving process in pre-project activities can be addressed. This allows the derivation of consistent requirements for method selection in different organisational situations.<sup>3</sup>

### 1.3 Research Approach and Outline.

This research aims to describe, analyse and to enable prediction of the selection of methods for innovation pre-project activities in different organisational situations and thus to develop a mid-range theory of pre-project innovation activities. On the continuum between minor working hypotheses and unified, inclusive theories, mid-range theories lie between the two.<sup>4</sup>

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<sup>3</sup> This issue will be discussed in chapters two and four.

<sup>4</sup> See chapter three for a comprehensive discussion.

This thesis will describe the results of the theorizing process and thus focus on plausible theory development rather than on testing theory.

The basic research paradigm or philosophy for generating new knowledge is neither close to positivism nor to the phenomenologist perspective. As there is already a vast amount of literature about the topic of innovation and also about the pre-project phase itself, existing theory will build the basis to access the topic. In a later stage, as soon as the theoretical framework is developed and propositions about method selection are developed, case study research will be used to validate and illustrate the framework in order to enable the development of hypotheses and requirements for the selection of methods in different situations.

Thus, the underlying research paradigm is neither truly positivistic nor is it a phenomenologist work either. As the research will be grounded more on theory and enriched by field data, the approach is closer to critical realism and to qualitative methodology. This approach will be discussed in detail in chapter three, where the research methodology is going to be discussed.

### **Chapter 2: Review of the literature.**

The aim of this chapter is to explain the key concepts in the context of the pre-project innovation phase and to deliver definitions of the key terminology. The result will be an outline of the limitations of existing research.

The literature review in chapter two shows that the concepts of strategy development and the development of innovation concepts are strongly interconnected and that there are several approaches to describe pre-project processes. However, to date there is only research on the organisational or strategic level with the result that organisational situations are either derived from strategy or from organisational factors. The conceptual level is only described in fragmented, specific aspects. However, it bears the potential to derive more consistent recommendations for method selection.

### **Chapter 3: Research methodology.**

In the research methodology chapter, existing concepts of research methods are going to be explained and an appropriate methodological approach will be developed.

In the first step, the concepts of theory and theorizing are going to be explained, as theory is a key result of research activity. Then, the concepts of research philosophy and paradigms are explained in order to show and select different methodological approaches and measures to assure a high degree of research quality. The chapter ends with a detailed strategy of how to develop a theory of method selection in the pre-project innovation phase.

### **Chapter 4: Understanding the theoretical grounding for the development of a theoretical framework.**

The objective of this chapter is the identification and development of key concepts and variables from existing theory in order to generate a theoretical basis to access the topic.

The interdependences of organisation and strategy are going to be further explored and interpreted from a conceptual perspective. The strategic perspective, the contingency view and the concept of problem-solving are going to be further elaborated in the context of the conceptual perspective in order to explain the concept of methods in the pre-project phase. The result of this chapter is an understanding of the pre-project innovation phase as a strategic problem solving process, which is dependent on an organisational situation.

### **Chapter 5: The development of a theoretical framework, and the derivation of propositions.**

The theoretical framework consisting of organisational situations, innovation pre-project activities, and methods will be developed, operationalised, and propositions about methods selection will be derived.

On the basis of the results chapter four, in chapter five the theoretical framework for the description of methods selection will be developed. The understanding of innovation as a strategic problem solving process allows the identification of two dominant factors that describe an organisational situation: the degree to which customer problems are solved by an offered product or service, and the degree to which collaboration is necessary in the value network. Further, the pre-project phase will be described by activity modules, which are conducted in parallel when developing and evaluating an innovation concept. Methods are selected and applied in pre-project activities, in order to collect, process and communicate information. The result of this chapter will be propositions about the selection of methods in different situations and activity modules.

### **Chapter 6: Evaluation and illustration of the theoretical framework, development of hypotheses and requirements.**

The objective of this chapter is to evaluate the theoretical framework by case study research, and to develop hypotheses about the framework, and to develop requirements for methods selection.

In the final step, the developed propositions are going to be evaluated through twelve case studies. The key concepts and their descriptive value will be evaluated, and hypotheses about the framework will be developed on the basis of a results discussion. In the final step, on the basis of the refined framework, requirements for methods selection will be derived for different organisational situations and activity modules.

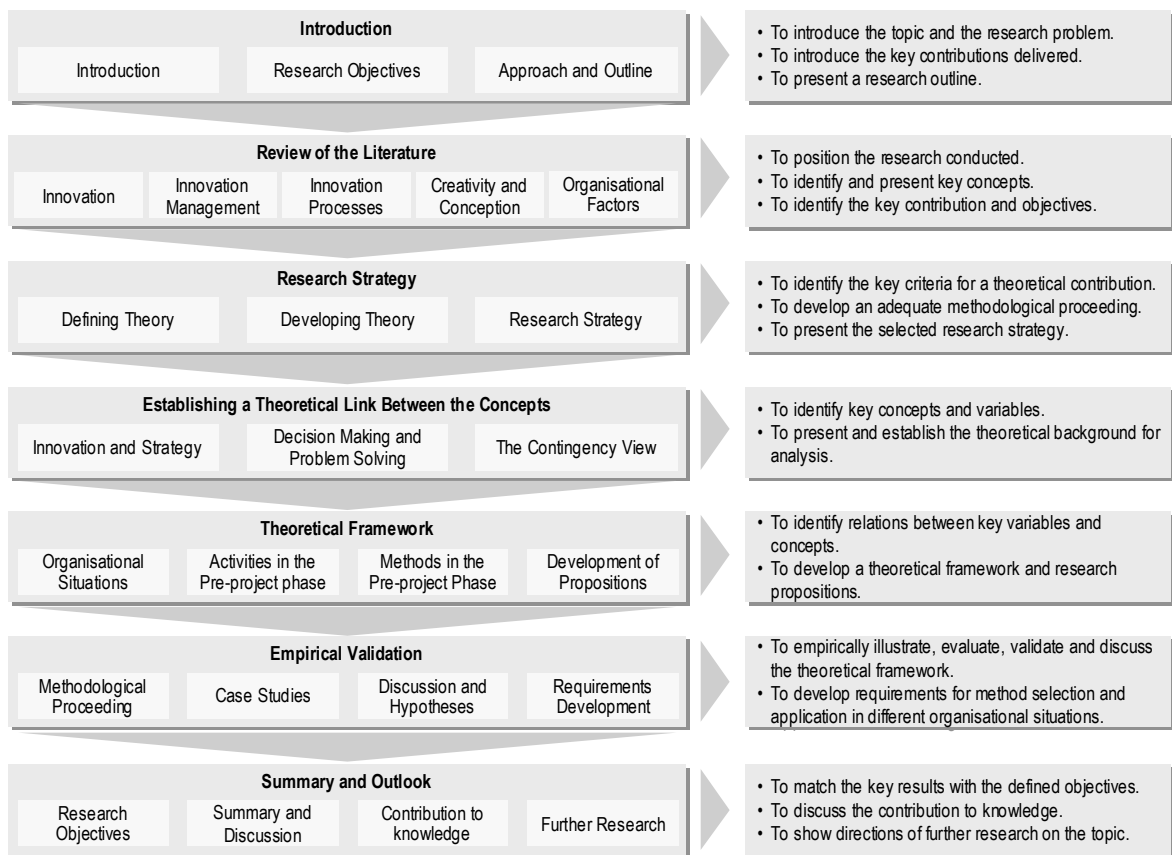


Figure 1: Thesis Structure, developed by the author.

## **2 The Pre-project Innovation Phase – a Review of the Literature.**

*Chapter Aims: In this chapter, I will provide an overview about the basic research that exists on the management of innovation and to clearly develop and state the research objectives.*

The objective of this chapter is to provide an overview about the phenomenon of innovation and the main areas of research on the phenomenon. The key objective is to understand the current state of research on the management of innovation, in particular the pre-project phase. In order to understand the current state, terminology has to be defined. Further, a frame of research has to be determined to clearly define the need and objectives for this research.

In order to achieve this, a general definition of innovation will be the starting point, then the more specific topic of management of innovation will build a basis for a detailed analysis of approaches on the conceptual level.

In the first step, the most important definitions of the term innovation will be analysed and the reasons for innovation are going to be explored. As the main reason for innovation is the quest for competitive advantage, the question about the means for innovation, or more specifically, the objects of innovation (products, services, processes) are described in order to focus the work on innovation related to product or service performance. On this basis, the question about the perspective and the degree of innovation and innovativeness will be central, and it will be explained that this research focuses on two dimensions: novelty of market and novelty to the innovator and as a result, a definition of the term innovation for this research will be developed.

In the second step, the management of innovation on a company level will be at the centre of investigation. It will be shown that on the strategic and the organisational level, the phenomenon is researched and explained to a high degree already. However, the conceptual level of innovation research, more concretely the development of concepts lacks integration with organisation and strategy, and therefore a detailed description of proceedings to idea development in different strategic situations is not possible. This insight will be the basic research question for this research project.



## 2.1 Innovation – Exploring The Phenomenon.

The term innovation is used in many different contexts. Especially in practitioner language, the term is often used as a synonym or metaphor for progress, technical invention or simply for something new. Souder and Sherman (1994a) call innovations the "*heartbeat*" (p3) of the world, as they create employment, economic growth and world progress and therefore are key to high quality of life and high standards of living. In innovation research however, there is a common understanding about the term itself. To call something new an innovation, two criteria have to be satisfied: invention and exploitation. In the following sections, the term of innovation will be described more precisely, the question of what the actual objects of innovation are and their degree of innovativeness will be explored in order to develop a basic understanding about the phenomenon.

### **An innovation is a successfully exploited, novel concept.**

An invention or an idea is not an innovation yet. According to Tidd et al (2005), an invention is only the first step of bringing an idea into practice. In order to become an innovation, an idea has to be brought to commercial and practical application. Invention is the conception of the idea, its subsequent transfer into the economy is called innovation (Trott, 1998). In 1967, the US Department of Commerce defined innovation as consisting of a theoretical conception, a technical invention and its commercial exploitation (US Dept of Commerce, 1967). Twiss (1974) also defines an invention as the result of conceiving an idea and innovation as the successful translation of the idea into the market. For Pleschak and Sabisch (1996), inventions are technical solutions to problems that require successful commercial exploitation in order to become an innovation. To Myers and Marquis (1969), innovation is an integrated process of idea conception, invention and market development.

Having an idea that solves a problem is not sufficient. In order to be an innovation, the concept has to contain a certain degree of novelty. Therefore, Gerpott (1999) defines innovations as qualitative novelties introduced into the market or an organisation in order to improve economic success. Analogous, for van de Ven (1986) an innovation is a new idea that may also be a recombination of existing concepts. An important factor is that an innovation challenges the present order and normally, the organisational problem-solving process, existing methods, processes and structures are not yet sufficient before the innovation has to be introduced and therefore the approach is perceived as new by the involved actors (van de Ven, 1986; Pleschak/Sabisch, 1996; Zaltman et al, 1973; Rogers, 1982). Novelty is a relative term, subjective to the observer. Van de Ven (1986) therefore suggests that novelty be defined relative to the people involved, although it may appear as an existing and established concept to others. Therefore, the question of novelty will be addressed in more detail in a later section. **As an intermediate result, an innovation is defined as a novel concept that is successfully economically exploited.**

### **Commercial exploitation is the most important reason for innovation.**

Commercial exploitation implies that at least one involved actor needs to have an economic benefit induced by the innovation. This raises the question, why do innovations occur. Joseph Alois Schumpeter (1912; 1939; 1942) was one of the first economists to research the importance of technological progress in the form of new consumer goods, new methods of production and transportation, new markets and new forms of industrial organisation as stimuli to economic growth (Schumpeter, 1912; Scherer, 1992). He is therefore called the "*godfather of innovation studies*" (Tidd et al, 2005, p 7). According to Schumpeter (1912), entrepreneurs seek to generate a monopoly by introducing innovations, as a monopoly allows them to optimise prices in a supply/demand function

## The Pre-project Innovation Phase – a Review of the Literature.

and thus to maximise profits (Fellner, 1951; Arrow, 1962). Schumpeter (1912) doubted the neoclassical view because of its assumptions of rational, maximising behaviour of economic agents who have given preference functions. Further the assumption of total information and the focus on static equilibrium states cannot be taken as realistic preconditions for analysis (Hodgson, 1994; Scherer, 1992). The critique on the neoclassical view is further illustrated by Rumelt (1984), who points out the factors of transaction costs, limited rationality, constraints on factor and information availability, and among others, technological uncertainty. Instead of an equilibrium view of markets, Schumpeter (1912) saw dynamic, evolutionary change as the basis for economic growth, and as a consequence, perfect competition as inferior compared to the dynamic model (Scherer, 1992). By trying to generate and protect a monopoly, entrepreneurs develop superior products and services and thus undermine existing market structures and positions of established firms, destroying existing monopolies in order to create their own (Schumpeter, 1942). Another reason for innovation can be to imitate the innovation in order to be part of an oligopolistic market and to start a diffusion process (Tidd et al, 2005). This process of creative destruction or diffusion creates new economic value.<sup>5</sup>

Innovations are not self fulfilling. Taking the perspective of creative destruction, innovations are investments for an entrepreneurial organisation (Pleschak/Sabisch, 1996). As innovations can create or destroy a monopoly, two groups of reasons to innovate occur: first, innovation can be seen as a means to reach an organisation's objectives in a novel way (Hauschildt, 1993) and therefore increase an organisation's performance (Tidd, 2001; Souder/Sherman, 1994a) and to create business prosperity (Cooper, 1994). On the other hand, reasons for innovation occur through external pressures like technology changes, changing customer needs, competitive activities and changing business environments (Sheth/Ram, 1987). Innovation goes along with closing strategic gaps, solving crisis situations, and exploiting technological solutions (Pleschak/Sabisch, 1996). As a result, innovation can be seen as a means to create differentiation of goods and services or cost reduction (Porter, 1985) and thus lead to better market positions and better resource utilisation (Wheelwright/Clark, 1992).<sup>6</sup> As innovation is always risky to a certain extent, organisations seek to protect their investments by several restrictive practices, like the use of intellectual property rights, for example (Porter, 1980; Scherer, 1992; Schumpeter, 1942).

As the definition above suggests, innovation can be regarded as a result or it can be viewed as a process (Trott, 1998). In the first case, it is necessary to further explore what can be the actual novel concept and therefore the object of innovation and further to what degree something is innovative. From a process perspective, it has to be further explored to understand what is necessary to conduct a successful innovation process. In the following two sections, the result-perspective will be kept. The process or organisational perspective will be taken in the subsequent sections.

### **Products, services and processes can be innovation objects.**

A successfully exploited, novel concept can be related to nearly every area in the context of innovating organisations. In the common literature, three main types are distinguished. Innovations can be related to products, services or processes (Tushman/Nadler, 1986; Tidd et al, 2005). Other authors (for example Utterback/Abernathy, 1975) only distinguish products and processes as objects

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<sup>5</sup> the discussion, which market structures are most suited to foster innovative activity is still ongoing. It is still unclear whether large, established enterprises or small entrepreneurs are the most successful innovators. Even Schumpeter himself came to completely different conclusions. Especially the problem of measuring innovative activity in the form of input variables like for example R&D expenditures and output variables like patent data is a problem of validity in research. For further discussion, see Scherer (1992) or Schumpeter (1912 and 1942).

<sup>6</sup> Tidd et al (2005) see Porter's framework as a good basis for analysis and innovation as a means for focus, differentiation and cost reduction. However, they are not aligned with the positioning thought, because the environment changes steadily. They further discuss the shortcomings of Porter's approach.

of innovation. This distinction is not used by every author, but most approaches can be subsumed under these categories.

The term of innovation itself is not only confused with the term invention (Tidd et al, 2005) but also is associated with new products (di Benedetto, 1994). The fact that innovation is associated with new products as an object is not surprising. This is supported by the fact that the largest amount of accumulated knowledge about innovation on the micro level is based upon research in industrial manufacturing (Gallouj/Weinstein, 1997). Therefore, it is necessary to stress that services deserve more attention in innovation research, as especially in advanced economies about two thirds of value is created in the services sector (Tether/Hipp, 2002). On the other hand, services themselves are very diverse and differences between them will lead to numerous exceptions when trying to derive generalisations, as for example insurances, prototyping, dentistry or cleaning count as services and some of them produce or improve technological artefacts (Tether et al, 2000). Unlike with products, services are of an intangible nature, there is a close interaction between production and consumption and human resources play a key role for many services. Intellectual property protection is weak in many services sectors (Tether/Hipp, 2002; Miles, 1996).<sup>7</sup>

Although services are in a peculiar situation, they cannot be completely separated from product innovations, as products and services become more integrated and many services can only be offered together with products. Due to this integrated view, Miles (2000) suggests further integration of services innovation studies with mainstream innovation research. As this research will focus on the early conceptual phase where customer problems and solutions are in the foreground, the distinction between product and services innovation is not regarded as helpful. The term products innovation will be used as a synonym for services innovation also.

Another group of innovations are process innovations. On the one hand, process innovations often follow product innovations while industries grow mature (Abernathy/Utterback, 1978) and aim to improve production processes of new products. As a further type, administrative innovations lead to optimised organisational structures that improve organisational performance (Klein/Sorra, 1996).<sup>8</sup> In both cases, innovation is a means to improve an organisation's processes for the production of goods and services either by technical means or with structural measures. In this research, focus lies on the value creation for customers in the early innovation phase. Therefore in this context, processes are only interesting research objects as far as they are changed in order to improve or change the product itself or as they can be considered as products for suppliers.<sup>9</sup> In both cases, the research focus is on creating value to customers.

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<sup>7</sup> For further discussion of innovation activities in the services sector, see Hipp et al (2000), Hipp (2000) or de Jong/Vermeulen (2003)

<sup>8</sup> Klein/Sorra (1996) modelise the process of implementing innovation in organisations, especially on the administrative level. They assume that implementation effectiveness (the consistency and quality of targeted organisational members' use of an innovation) is a function of the strength of an organisation's climate for the implementation and the fit of that innovation to targeted user's values. They address several implementation issues like resistance, avoidance, compliance and commitment.

<sup>9</sup> Construction machines for example, can be seen as a product innovation for the producer of the machines. For customers, they are regarded as process innovations. In this research, construction machines would be of interest, if they are analysed from the perspective of the producer, or from the perspective of the customer but only if the new construction machines enable the customer to produce completely new problem-solutions with the new machines, which haven't been offered before.

### **The distinction of degrees of novelty leads to consistent research results.**

Innovation can help to generate a monopoly or to destroy one which implies the creation of a new market. Innovation has been defined as a novel concept that is also economically exploited; knowing that innovation can be conducted by products, services and processes, then not every innovation needs to create a monopoly but can also aim to destroy or sustain one by entering this market or by sustaining competitive advantage. Therefore the question arises, from which point on an innovation is a destructive innovation and when it is not. Thus, this section concentrates on the gradual dimension of innovation description.

The need to distinguish consistent degrees of innovativeness arises from the need to develop consistent research results and to enable knowledge accumulation (Garcia/Calantone, 2002). However, there is lack of consistency and common understanding about the gradual dimension in innovation research, which accrues to a substantial obstacle to the generalisability of research results (Wolfe, 1994; Tidd, 2001). In the course of an extensive review of the literature about innovativeness, Garcia and Calantone (2002) have identified fifteen constructs and 51 different scale items in just 21 empirical studies that model product innovativeness. This lack of consistency in operationalisation has resulted in confused and interchangeable use of the constructs that define the degree of innovativeness of a product. This problem has also been recognised by Chandy and Tellis (2000) and Green et al (1995).<sup>10</sup>

Garcia and Calantone (2002) identify one single consistency in the definitions of the constructs: innovativeness is always modelled as the degree of discontinuity in marketing and/or technological factors. This result should not surprise, as it appears to be a circular statement because innovation is defined by (technological) concepts that are economically exploited in markets. They define innovativeness "*from a macro perspective [...] [as] the capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure in an industry. From a micro perspective, innovativeness is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy.*" (Garcia/Calantone, 2002: p113). Based on the definition of innovation, this description of innovativeness is plausible and will be used as a basis for further discussion. Not only can products be seen as innovative, but also organisations can. An innovative organisation is capable of introducing a large number of innovations. The construct is measured by organisational, financial and product-related variables (Garcia/Calantone, 2002). In this research, the focus lies on product-related innovations, as stated in the section above, and therefore the concept of innovativeness will not be further explored in an organisational context.

One criterion for an innovation is novelty of the concept. However, novelty is a term relative to subjective judgement, and therefore three major questions arise in the context of innovation: new to whom, to what degree, and with which implications (Hauschildt, 1993). As stated, there is little consensus about what is considered as new to whom. Focusing on products and services, they can be new to the world (Song/Montoya-Weiss, 1998), new to the innovating organisation (Booz et al, 1982; Danneels/Kleinschmidt, 2001), to the industry (Abernathy/Utterback, 1978) or to the customer (Danneels/Kleinschmidt, 2001; Cooper, 1979). The customer perspective is more in focus in the context of consequences and therefore described in more detail in a later section. The new-to-the-world perspective does not promise deeper insights because it does not concentrate on a special actor as research object. Thus, for the degree of novelty to whom, the market and the organisational perspective remain relevant for this research.

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<sup>10</sup> this lack of consensus leads to the situation that in nearly every new research in the context of innovativeness, the constructs are newly defined and thus, as a result confusion and lack of generalisability are even aggravated.

**Innovations can be new to the market or create new markets.**

New to the market can mean creating a new market in the sense of Schumpeter (1912) or to introduce a new product into an established market. The product life cycle illustrates the product performance (e.g. generated revenue or profit) over time. In the beginning, a product needs to be developed and before it is introduced. Naturally it generates only costs as there can't be any revenue. In the Introduction phase, performance is rising and the product spreads through the market. In the phase of saturation, revenue stagnates and in the final phase, the product revenues decline (Cox, 1967; Levitt, 1965; Polli/Cook, 1969; Bayus, 1994) The following illustration shows the concept of a product life cycle.

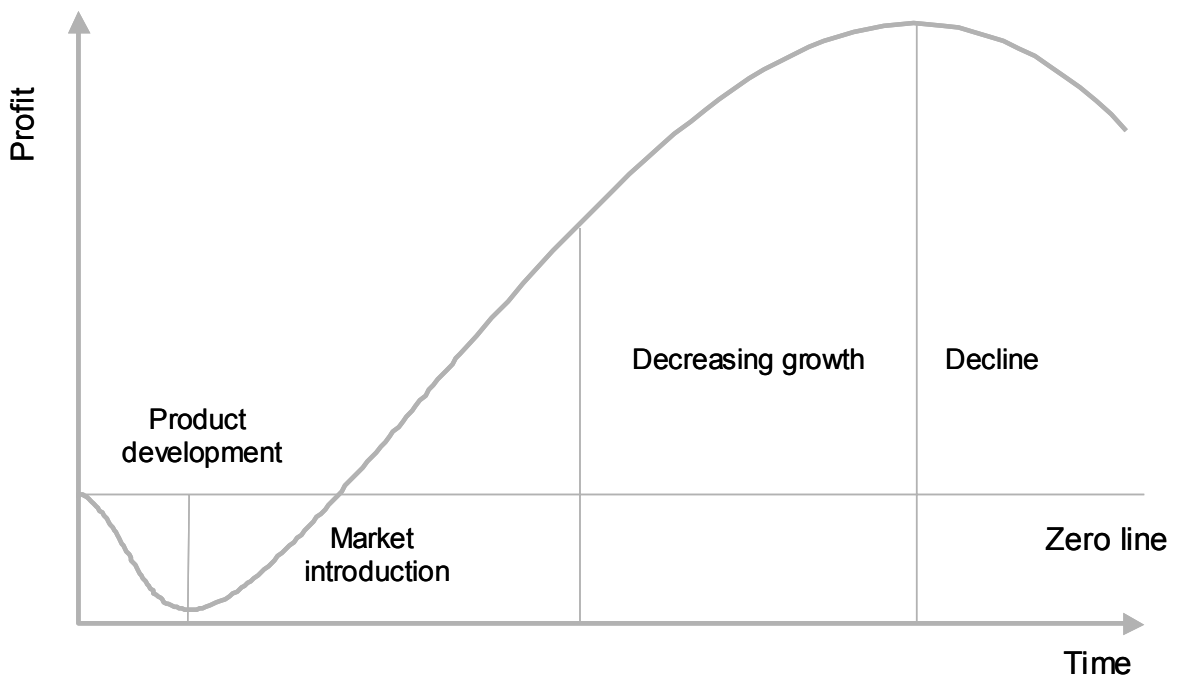


Figure 2: The product life cycle, modified from Bayus (1994).

Similar to the product life cycle, Abernathy and Utterback (1978) develop a model of industry life cycles. When a new product is introduced, in the first period there are a large number of entrants offering a large variety of different versions of the new solution, and new entrants imitate the new products. The second phase is one of standardisation and convergence. Dominant solutions (dominant designs) remain in the market, weaker ones are shaken out and the number of market players is reduced. In the third phase, the remaining actors concentrate on efficiency, and the number of new entrants decreases significantly (Klepper, 1996). Therefore in the first phase, there are product related innovations to expect, while in the later stages the number of process and efficiency related innovations grow. The following illustration shows the concept of Abernathy and Utterback's (1978) industry life cycles.

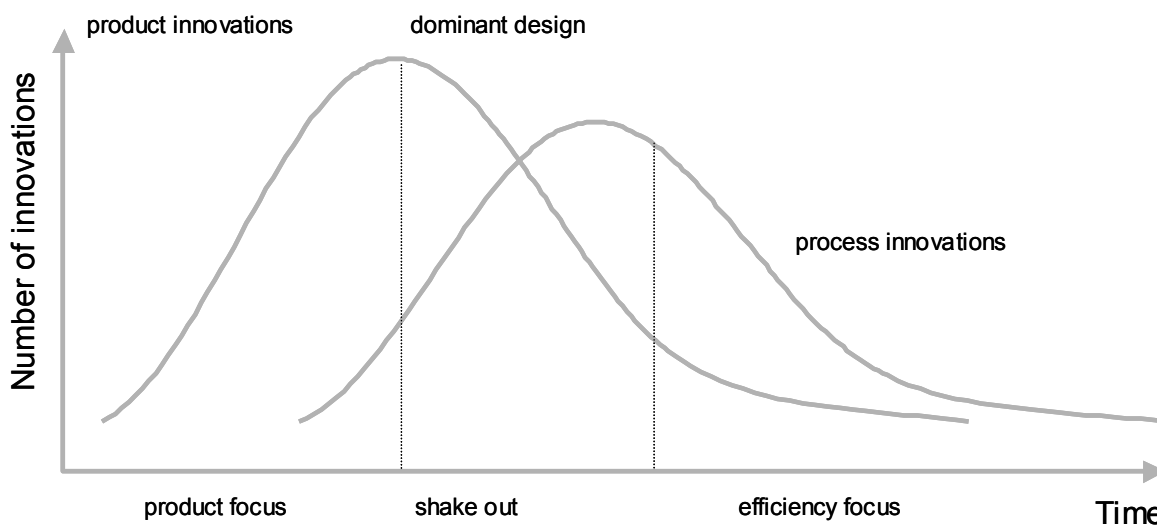


Figure 3: Industry life cycle, modified from Abernathy/Utterback (1978)

Central to these models is that they focus on mass markets and industrial products (Teece, 1986). Further, as technologies, competition and organisational capabilities are different in industries, the length and frequency of cycles, the existence of dominant designs and the number of entrants can vary. These models are very suitable for products, where consumer tastes and needs are homogenous, clearly defined products exist (Suárez/Utterback, 1995) and there are rich opportunities for product and process innovation (Abernathy, 1978; Pavitt/Rothwell, 1976). However, changes in these diffusion curves can be measured and calculated dependent on firm strategy (Kuester et al, 2000), marketing mix (Bass et al, 2000) as research in the field of quantitative marketing shows (Mahajan/Peterson, 1985).

### **Innovations new to an organisation demand for new structures.**

Innovations are not only defined as being new to the market. Several authors also take the more general (new to the people involved, van de Ven, 1986), or the perspective of the adopting organisation (Zaltman et al, 1973) or the innovating organisation (Crawford, 1991). As an adopting organisation can be viewed as a customer of innovations and the term of people involved is too general, in this section focus remains on innovating organisations.

The product life cycle schema shows the phase before market introduction. Although this phase appears short compared to the other phases, here the future success of the product is determined. Not only the decision of how and whether or not to develop a product but also the development of the product itself are taking place at this stage (Cooper, 1979). Thus, it stands to reason that if a new product is familiar to an organisation, this phase is more likely to be successfully pursued than it would be in the case of a completely new product (Danneels/Kleinschmidt, 2001). Danneels and Kleinschmidt (2001) suggest defining novelty to an organisation as determined by environmental familiarity, project-firm fit, technological and marketing aspects, technological familiarity, marketing fit, technological fit and new marketing activities. They assumed that these variables influence new product performance, although only the measures of fit show significant influence. However, even if familiarity has no significant influence on product performance, it definitely determines the way organisations have to organise and manage their first stage of product life cycles. Research suggests that more innovative products require more firm resources and a different development approach (Colarelli-O'Connor, 1998; Lynn, 1998; Lynn et al, 1996; Veryzer, 1998).

### **Different degrees of novelty lead to different effects on markets and organisations.**

Significant innovations allow firms to establish superior positions in the competitive environment (Danneels/Kleinschmidt, 2001). The question arises, when an innovation can be called significant and to what degree. One of the earlier categorisations in the gradual dimension is by Ansoff (1957), who distinguished incrementally new products, moderately innovative products and really new products. The dimensions used for this categorisation are the questions of whether the products are existing or new and whether the corresponding market is existing or new. When a product is existing, and the market is established too, then this product improvement is an incrementally new product. When a market is new, but the product existing or the product is new, but the market is existing, then Ansoff speaks about moderately innovative products. In the case that both are new (product and market), then the innovation is a really new product. Similarly, Tushman and Nadler (1986) distinguish incremental changes, synthetic (combining existing ideas) and discontinuous innovations. In their definition discontinuous innovations imply the application or development of significantly new technologies or ideas and therefore require new skills and organisational structures and processes throughout the organisation. More generally, Gatignon and Robertson (1991) distinguish continuous innovations that have minimal effect on behaviour patterns, dynamically continuous innovations which have moderate effect on behaviour patterns, and discontinuous innovations which create new patterns.

Cooper (1979) describes three dimensions to define product innovativeness: newness to the firm, uniqueness of the product and product superiority. The higher the values of each variable, the higher innovativeness is. This distinction is used to measure the impact of product innovativeness to new product and firm performance and therefore this is an example for the definition of innovativeness for a special purpose. The more general approach of using a dichotomic (incremental versus radical) or triadic distinction of newness as Ansoff (1957), Tushman and Nadler (1986) or Gatignon and Robertson (1991) use, is more common, but also specific to the respective research context.<sup>11</sup>

When an innovation allows a completely new market to be created, then changes surely affect participants differently than in the case of incremental innovations. New products have to be adopted by new or existing customers, and thus their behaviour patterns have to change, and they face a certain adoption or investment risk (Danneels/Kleinschmidt, 2001), because before they decide to adopt the innovation, they normally do not know whether the product will satisfy their needs better than these have been satisfied before adoption.

New products have to be produced, and this often has not only to be organised within one single organisation, but in a value or supply chain of involved organisations (see Porter (1980, 1985), for example). Therefore, the more different the innovation is to the product that has been produced before, the more different competences have to be acquired, especially for discontinuous innovations, where paradigm shifts take place. This involves competence and structural changes in organisations, where the whole business model of an organisation can be affected or even displaced (Ehrnberger, 1995; Veryzer, 1998, Rice et al, 2002). Tidd and Bodley (2001) analysed 50 development projects in 25 firms and compared projects with higher novelty with those of lower novelty. Results suggest that in projects with higher novelty, structures and methods differ significantly: the role of team composition was stressed and the involvement of partners in the value chain was twice as likely than in projects of lower novelty.

As a result, innovative products open great opportunities in terms of growth into new areas (Danneels/Kleinschmidt, 2001), but also imply structural changes within and outside of organisations. Technologies and products are not the only source of discontinuity. Markets can change due to

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<sup>11</sup> For an extensive discussion of the terminology, see Salavou (2004), or Garcia and Calantone (2002).

## The Pre-project Innovation Phase – a Review of the Literature.

political reasons, supply risks and regulatory changes (White/Bessant, 2004; Tidd et al, 2005). Therefore, radical innovations are not only induced by the innovators' objectives but also induced by external factors that influence the innovators' objectives. To analyse these different reasons and effects of changes, different frameworks for innovation typologies have been developed.

The categorisation of innovation types is used to describe effects of the respective innovation type on the involved actors. For this reason, authors use more than one dimension of newness in order to generate a more differentiated analysis. For this reason, different perspectives have been taken. Christensen (1997) compares technology performance and customer expectations to technology performance. When a technology or product is below the existing performance standards but manages to satisfy customer needs at a lower price, a disruptive innovation could emerge. Innovations that sustain the existing performance standard, are called sustaining innovations.

The Booz Allen & Hamilton Framework classifies different types of innovation along the two dimensions new to the market and new to the customer, resulting in improvements to existing products, new product lines, additions to existing product lines, new-to-the-world products, cost reductions and repositionings (Booz et al, 1982). Abernathy and Clark (1985) distinguish innovation types along the dimensions of sustaining or enhancing competences and creating or destructing relationships. They come to the types of niche creation, regular, revolutionary and architectural innovations.

In this research, the type of innovation addressed is novel to the innovating organisation, as otherwise a certain degree of a conceptual problem would not exist. Further, the analysed products and services should generate competitive advantage and not only compensate competitive disadvantage. This implies innovation that either generates a new market, enables entering a young market or changes an existing market. The discussion will become more detailed in chapters four and five.

These typologies provide a brief overview about the need for categorisation and possible innovation types developed in the context of specific research problems. To summarise, the type of innovation and the strategy behind it influence the innovation processes. Therefore, focus lies on the management of innovation on a company level in the next section.



## 2.2 The Management of Innovation.

The innovation process is defined by the activities in the first two sections of the product life cycle, beginning with a first conceptual idea, ending with the market introduction of the product (Cooper, 1992). To date, there is no general and comprehensive framework to guide innovation research and management practice (Tidd, 2001). The reasons for this situation are based on the fact that innovation itself is cross-functional and the research topic is analysed by a variety of disciplines, like economics, marketing research, sociology and psychology, organisation research, technical disciplines and strategic management, and therefore many different methodological approaches have been adopted (Tidd, 2001; Trott, 1998; Tidd et al, 2005). This variety has caused several methodological shortcomings in innovation research, as exemplified by the number of different innovation typologies, which have been described in the sections above. Ernst (2002), for example analyses empirical studies about new product development over the last decades and comes to the conclusion that most research undertaken is below the standard of research methods in other sciences. As an important example, he states that the very influential research works of Cooper and Kleinschmidt (e.g. 1984, 1991, 1994, 1994a, 1995) have not changed and they have not developed their methodology for the last thirty years, although situations of organisations and research methods have changed very much. Also in publications of other researchers, methodological advancements have not been applied. Further, as Tidd (2001) asserts, most studies have failed to include measures of success for their recommendations and therefore cannot be transferred to management prescription. Others base their data selection on too specific data sets with the result that they lack generalisability. Not only the methodological approach, but also the applied methodological rigour in innovation research leads to the named shortcomings. Ernst's (2002) results suggest that variables often have not been derived from robust theory and therefore a flood of confusing findings have been developed that lack comparability. Methodological rigour is not the only problem. The environment in innovation research is ambiguous and fast-changing. Therefore as Tidd (2001) states, it is difficult to identify the contribution of innovation to performance because the relevant variables (input, process and output) cannot be measured reliably and constructs cannot be determined as entirely valid. Thus, establishing relationships between these factors and business performance is challenging. He further asserts two examples of approaches to measure innovation on the firm level: using public domain indicators like expenditures, patents and new product announcements or using survey instruments to capture internal indicators. Thus, not only methodological rigour is the reason for lacking comparability, but also a lack of and consistency of data and information is a problem in innovation research. As a consequence, management prescriptions from innovation research are based mainly on success factors that can be confirmed *ex post*, while *ex ante* no definite recommendations can be made.

Current research approaches to the management of innovation take many different perspectives. Brown and Eisenhardt (1995) identify three streams of research on new product development: the rational plan approach, the communication web and the disciplined problem solving approach. In the rational plan model, performance effects of factors like team composition, team organisation, the team process, senior management involvement, product effectiveness, market nature, customer and supplier involvement are researched (Cooper/Kleinschmidt, 1987 for example). The communication web paradigm focuses on the issue of internal and external team communication, team composition and project leadership on performance (see Allen (1977), for example). The disciplined problem solving model is slightly more complicated, as there are two dependent variables, process performance and product concept performance in the light of independent problem-solving teams under subtle top management supervision. In this stream, researchers also focus on the variables of team composition, team organisation, team process, project leadership, senior management

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involvement, supplier and customer integration (e.g. Takeuchi/Nonaka, 1986). Khurana and Rosenthal (1998) criticise Brown/Eisenhardt's distinction, as the new product development process is too complex to be completely understood by one of these research perspectives. Thus, in the next sections different viewpoints will be used to understand the nature and success factors for the early phases of new product development.

In the following sections, the management of innovation processes – especially of the early phases – is going to be described. In the first step, process models are going to be introduced in order to define more clearly the focus of this research. In the subsequent steps, the concepts of creativity and organisational factors for the management of innovation processes will be introduced.

## 2.3 Process Models of New Product Development.

Innovation is connected to the organisational problem-solving processes (Pleschak/Sabisch, 1996), more specifically to the problem of generating economic value in a competitive environment. According to Kay (1993), value added is the difference between the market value of outputs and the cost of all inputs. Hence, there can be no long-term rationale for a firm that does not add value (Tidd, 2001). As a result, an organisation needs to identify market needs, be able to define an offering and set up the process for production of goods and services that allows them to create the necessary value. Thus, the resources devoted to innovation can only be justified in so far as they support the attainment of organisational objectives (Twiss, 1974). Therefore, it is essential that effectiveness and time efficiency shape the process (Cooper, 1994).

### **Innovation is the fusion of market needs and technological opportunity.**

Holt (1978; 2002) introduces the fusion model that describes a product idea as a fusion of a user need and a technological opportunity. Therefore, information about user needs leads to a problem definition and information about user concepts leads to technical opportunities. The problem of developing a product concept is multi-faceted. The problem is influenced by market, technological, economic, ecological, legal and human factors. As a consequence, Holt develops the multi interest concept that includes rational and emotional needs from users, employees, society, financial suppliers, the firm itself and its owners. User needs, for example, can be distinguished in direct rational and emotional needs and indirect needs that are arising before (ex ante) or after (ex post) the purchasing decision. While direct rational needs can be explored relatively easily, indirect and emotional needs are hard to predict as they may vary between groups and individuals. His considerations result in the life cycle of the product innovation process, starting with the generation of ideas, followed by utilisation of ideas, preparation for implementation, the implementation itself and the disposal of a new product.

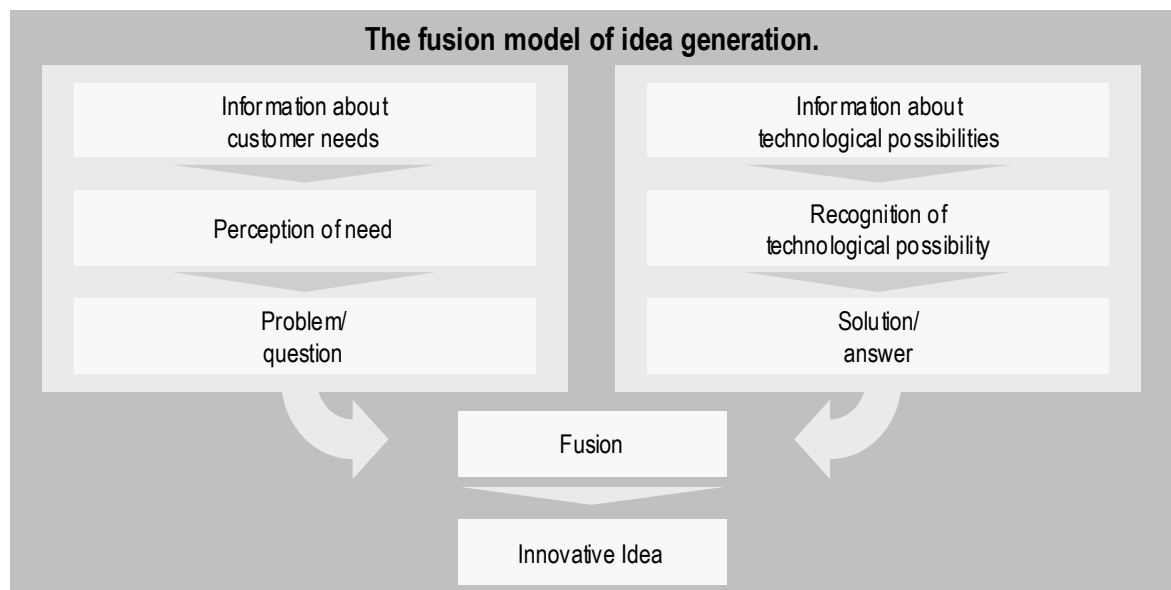


Figure 4: The fusion model of idea generation, processed from Holt (1978)

A closer look at Holt's (1978) fusion model leads to the conclusion that product concepts can arise either from articulated user needs or can be developed from technological possibilities (see also von Hippel, 1978 or Trott, 1998). Rothwell (1994) has observed a shift in focus in the development of innovation over the last four decades. While in stage one, rising prosperity and advanced technological possibilities and free production capacities have led to a technology push paradigm, in stage two a market or demand pull paradigm emerged due to very limited resources in the oil crisis time. In the eighties, a cost control and waste reduction phase emerged from increasing competition between western countries and Japan. Caused by severe resource constraints, coupling of activities was the result and therefore the product development process was seen as a sequential process of interdependent stages. From this time on, innovation was no longer considered a linear process as assumed before (Trott, 1998). By the availability of enhanced IT measures, process efficiency was further increased and thus parallel activities were made possible for marketing, R&D, product development, engineering, and manufacturing. In the future, with globalised and increased competition and shortened product life cycles (Tidd et al, 2005), speed, performance and quality gain further importance in the process and further integration of activities will emerge. This will enable organisations to be first to the market offering economic benefit in order to attain greater market share, monopoly benefits or increased customer satisfaction (Reiner, 1989; Rothwell, 1994).

### **New product development can be seen as a decision process.**

One of the most influential researchers on new product development is Robert G. Cooper, together with Elko J. Kleinschmidt. Cooper's research is based on the assumption that a well-designed new product development process has to be effective and efficient in order to increase business prosperity. A high quality new product process has a strong impact on new product performance (Cooper, 1992, 1993, 1994, 1996). He stresses the importance of success factors like a unique and superior product, strong market orientation, doing the upfront homework, sharp and early product definition, cross-functional teams in development, tough evaluation and decision points and a high quality of execution. A unique and superior product has unique attributes, delivers good value for money, meets customer needs, offers relative product quality, good price/performance characteristics, and visible and measurable product benefits. Strong market orientation results from idea generation together with customers, conducting product design market studies, close interaction with customers especially in technology push situations, all conducted through the entire project. Doing the upfront homework implies environment screening, conducting market studies, technical feasibility assessments and building a robust business case.

In addition to a high quality process, a clear and well-communicated new product strategy (meaning goals and objectives for total new product effort, the role of new products in achieving these objectives, clearly defined arenas and long-term focus), adequate resources (involved senior management, sufficient budgets and sufficient manpower) are the corner stones for new product development success. (Cooper/Kleinschmidt, 1995) The following table illustrates the success factors developed by Cooper and Kleinschmidt.

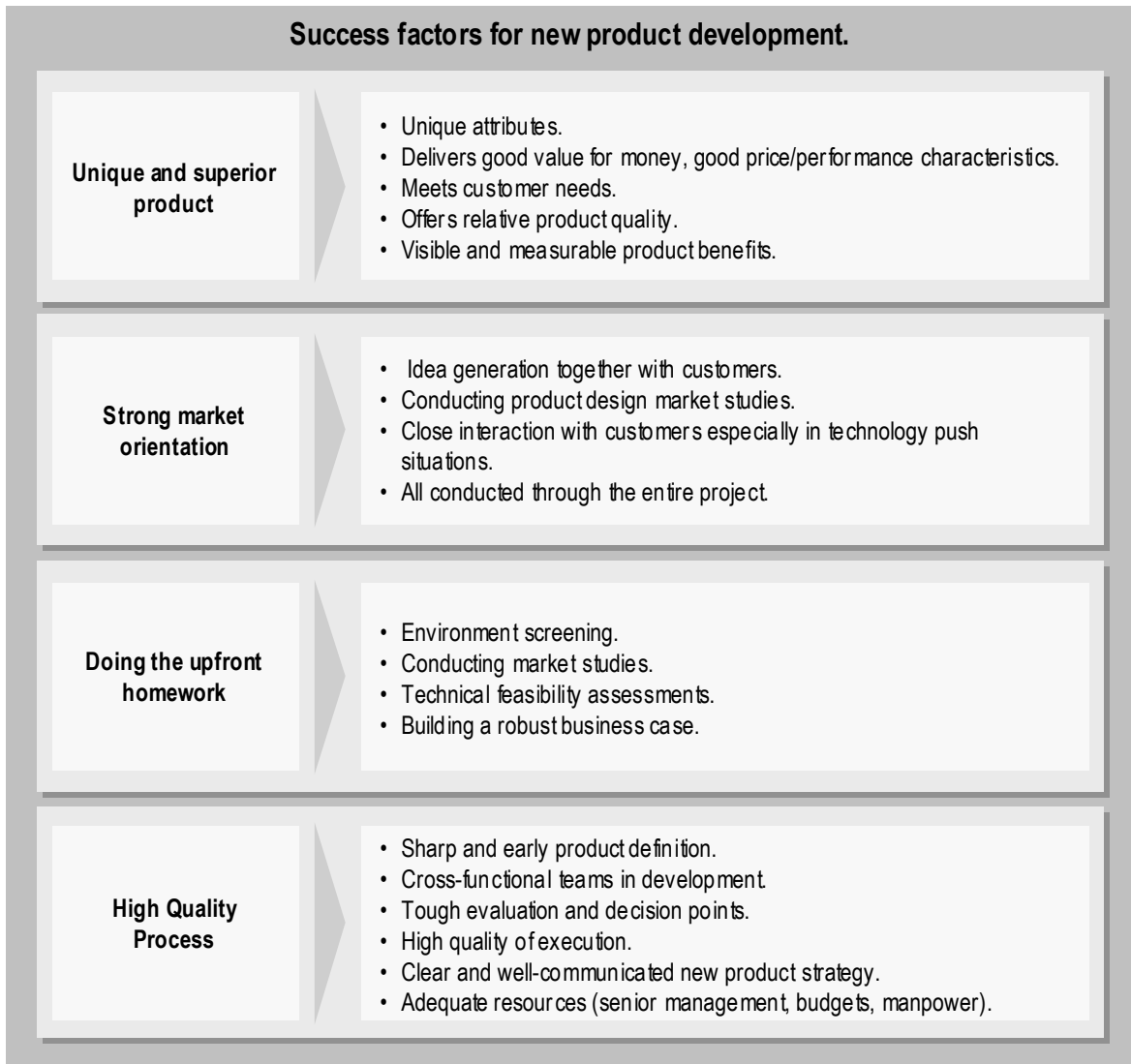


Figure 5: Success factors for new product development, processed from Cooper/Kleinschmidt (1995).

According to Cooper (1992), innovation success is defined and measured by an organisation's expectations in profit rating, market share, sales objectives, profit objectives, technological success, impact on the innovating firm's performance, time efficiency and adherence to schedule. Thus, innovation success is absolutely subjective and individual to an organisation. If success is determined by subjective measures, a process that includes these criteria is necessary in order to make successful new product development possible. In order to achieve this, Cooper (1993 or 1996, for example) develops stage gate process models. These break the innovation process into a predetermined set of stages, each consisting of a set of prescribed and parallel activities. The beginning of each stage is defined by a gate that controls the process and serves as the quality control check point. Gates have a defined input, determined criteria for evaluation, and defined outputs like decisions, priority levels and the definition of the next gate date.

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- Stage one is a preliminary investigation and scoping of the project.
- In stage two, a detailed investigation and the detailed basic evaluation leading to a business case is conducted. This includes market research, user needs evaluation, a detailed technical and manufacturing assessment, and a detailed financial and business analysis.
- Stage three is the development phase: the product development, meaning the actual design of the new product, the implementation of the development plan, the prototype development, first in-house testing and limited customer testing are conducted. Further, the manufacturing process is mapped out and market launch is planned. Here, a cross-functional team consisting of marketing and technical staff, manufacturing specialists, quality assurance and finance staff is key to success.
- Stage four is the testing and validation phase. Here, extensive in-house testing, field trials, pilot and pre production trials, trial sell are taking place.
- In stage five, full production and market launch are conducted.

Cooper's stage gate model focuses on the development of new products from an idea to the market. As already stated in the introductory chapter, this research focuses on the early and pre-project stages. Cooper stresses the importance of doing what he calls the upfront homework and that it is crucial to have a clearly defined product strategy as a basis for the process. Together with Rothwell's (1994) assumption that processes become more and more synchronous due to increased competition and due to the fact that more radical innovation has a significant impact in an organisation's strategy as described in section 2.1, an existing and clearly defined product strategy cannot exist but is co-developed in this first stage when innovations are more than improvements of existing products. In the next sections, exploration focuses on the pre-project stage one and the stage before that, which has not been described by Cooper.

### **This research focuses on the pre-development phase and pre-project activities.**

Another way of describing the new product development process is a funnel analogy. Goffin et al (1999), for example, develop a funnel and tunnel model that can be interpreted as a mix of Cooper's stage-gate model and the idea that concepts become more concrete over time and therefore affords different management emphasis. Wheelwright and Clark (1992) use a funnel model to illustrate that the number of ideas or concepts are large at the beginning and decrease at the end of the process, when more concrete ideas are left.

Goffin et al (1999) divide the overall funnelling process into two major phases: the pre-development and the new product development phase. The strategic scope is visualised by the width of the funnel, and ideas are generated until the first idea review. In the next stage, further investigations lead to an investigation review. The most promising investigated ideas will be developed in the next phase, the product concept development. The concept review defines the end of pre-development. The new product development phase is divided into the stages of product definition, design specification, detailed design, test and evaluation and product introduction. Each stage is followed by an individual review process. The new product development phase shows similarities to Cooper's stage-gate process, but the pre-development phase goes into more detail in what Cooper describes as upfront homework. Especially in the first stage, the ideas development phase, Goffin et al (1999) see strategy development as a parallel activity to idea generation, and in the investigations stage, strategic portfolio management is conducted in parallel to the concept shaping. For the strategy development, they suggest a structured approach that is defined by setting a strategic direction or vision, involving managers from key functions, setting strategic objectives and communicating

process and outcome. Thus, the idea generation process is embedded in the strategy formulation process.

The funnelling models and the stage gate model are not exclusive. Therefore, the following illustration shows a summarising joint view. This research focuses on the left hand side, the so-called fuzzy front-end (Smith/Reinertsen, 1991).

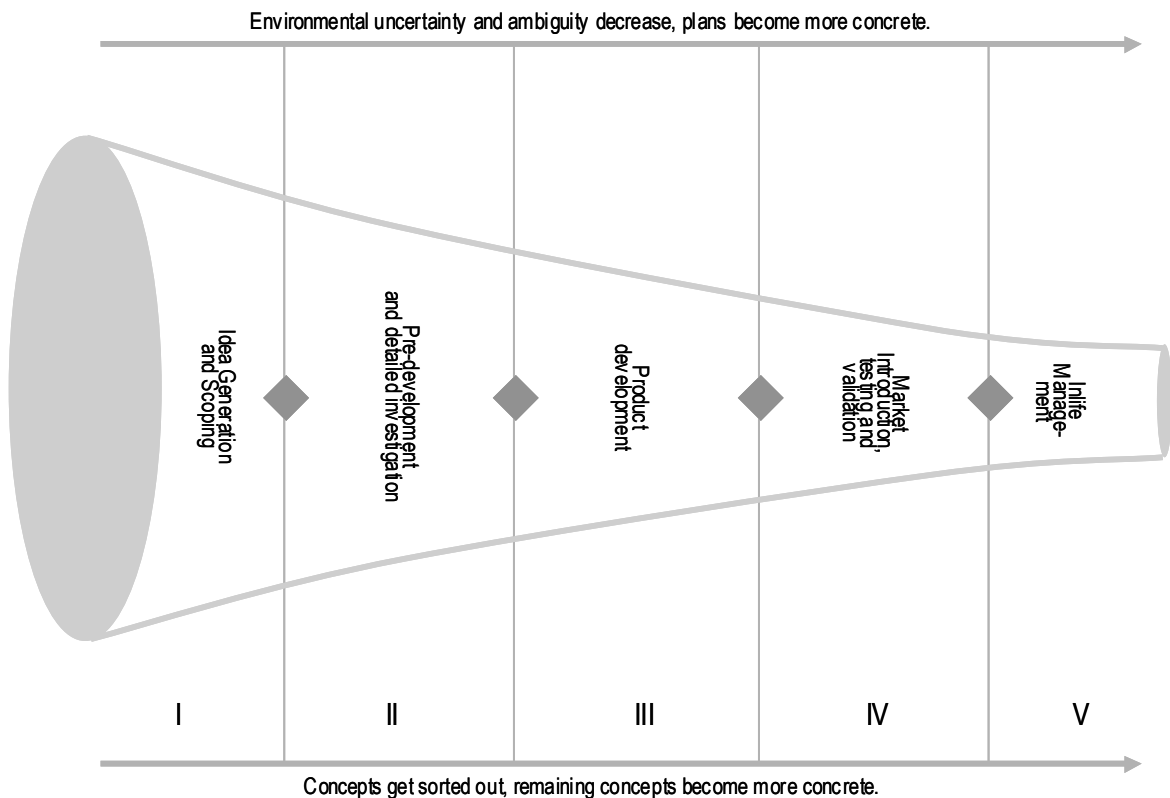


Figure 6: Funnel and gating model, adapted from Cooper (1992) and Goffin et al (1999).

Khurana and Rosenthal (1997; 1998) stress that the importance of the phase before a go/no-go decision is key to success in new product development and develop an approach for describing and designing the pre-project phase. They suggest that symptoms like abruptly cancelled new product development processes and late market introduction could be avoided, when a clear strategy and priorities for the projects are defined. Thus, they see new product development as a core business activity that needs to be integrated in the business strategy process and that new product development had to be managed through analysis and decision making (Khurana/Rosenthal, 1997; Bowen et al, 1994). They describe the front end as a process to independently analyse activities and their interrelations, although they are performed partially in parallel. To describe the process, they distinguish foundation elements and project related elements. Foundation elements are a clear product strategy, a well-planned portfolio of new products, a facilitating organisation structure and cross-functional teams. Project specific elements are a product concept, market requirements, plans, schedules and estimates (Khurana/Rosenthal, 1997). They stress that product strategy, product concepts and business strategy have to be developed simultaneously and that there is a need for three kinds of visions: a business vision, a project vision and a product vision (Bowen et al, 1994). This description is analogous to Goffin et al's (1999) description of the pre-development phase. What is different is their description of the pre-project phase as pre-phase zero (the preliminary opportunity identification, idea generation, market/technology analysis, product & portfolio strategy), phase zero

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as the product conception, and phase one as the feasibility and project planning, which can be seen as Cooper's stage one.

In the front end phase, customer needs have to be identified, markets have to be segmented, competitive situations evaluated, technology and core product requirements have to be defined and strategies have to be aligned. One key task therefore in the front end process is to reduce environmental and project related uncertainties by closer communication, commitment and by a decentralised project structure (Khurana/Rosenthal, 1998; Moenart et al, 1995). Thus, with increasing uncertainty the specific approach to the front end including the desired explicitness of the process depend on the radicalness of the product, the nature of the market and the interaction within the organisation.

Khurana and Rosenthal (1998) have conducted an extensive literature review and categorise four major success factors: product/strategy alignment, sharp and early product definition, a clear project definition and clearly defined organisational roles. Thus, the higher the uncertainty and product radicalness, the less that standardised processes will promise success, but evolutionary development of concepts is necessary. As a result, successful organisations manage to link business strategy, product strategy and product-specific decisions, and senior management provides consistent leadership in integrating diverse sets of information and decisions. Further these organisations have the ability to understand the significance of a holistic view to the front end (Khurana/Rosenthal, 1998).

### **Innovation pre-project processes cannot be described sequentially.**

According to Tidd et al (2005), the innovation process is a core business process of searching, selecting, implementing and an additional learning loop. Thus, what is called upfront homework by Cooper or pre-phase zero by Khurana and Rosenthal, in this framework is the searching process. It comprises the tasks of defining boundaries of the market place, understanding market dynamics, trend-spotting, monitoring technological trends, market forecasting, technological forecasting, integrated future search, learning from others, involving stakeholders and insiders, mistakes management, and finally communication with and connection of involved people.

As an intermediary result of a funded, applied research project, Koen et al (2001) model the front end innovation process. In their description, they distinguish environmental influencing factors, the organisation as an engine for innovation and tasks performed within the organisation. These tasks are idea genesis, idea selection, concept and technology development, opportunity identification, and opportunity analysis. They explicitly distinguish the front end of innovation and the new product development phase, as shown in the following table.



<b>The front end of innovation compared to standard new product development.</b>		
	<b>Front end of innovation</b>	<b>New product development</b>
<b>Nature of Work</b>	<ul style="list-style-type: none"> <li>• Experimental.</li> <li>• Often chaotic.</li> <li>• Difficult to plan.</li> <li>• Containing eureka moments.</li> </ul>	<ul style="list-style-type: none"> <li>• Structured.</li> <li>• Disciplined.</li> <li>• Goal-oriented with a project plan.</li> </ul>
<b>Commercialisation Date</b>	<ul style="list-style-type: none"> <li>• Unpredictable.</li> </ul>	<ul style="list-style-type: none"> <li>• Definable.</li> </ul>
<b>Funding</b>	<ul style="list-style-type: none"> <li>• Variable.</li> <li>• Some projects are bootlegged, others are funded.</li> </ul>	<ul style="list-style-type: none"> <li>• Budgeted.</li> </ul>
<b>Revenue Expectations</b>	<ul style="list-style-type: none"> <li>• Often uncertain.</li> <li>• Speculation.</li> </ul>	<ul style="list-style-type: none"> <li>• Increasing certainty</li> </ul>
<b>Activity</b>	<ul style="list-style-type: none"> <li>• Individual and team.</li> </ul>	<ul style="list-style-type: none"> <li>• Multi functional product and process development team.</li> </ul>

Figure 7: Differences between the front end of innovation and product development processes, Koen et al (2001).

One of the most challenging questions for researchers and practitioners alike who aim to describe, analyse and design the front end process is the question, at which point of time the actual process begins and where it ends. While most researchers agree about the ending of the front end which is the decision as to whether an organisation is willing to invest in the developed idea or not (Cooper, 1992; Khurana/Rosenthal, 1997/1998; Reid/de Brentani, 2004; Massey et al, 2002), there is not a consistent definition about the beginning. Reid and de Brentani (2004), for example see the front end as the activities before first team alignment and therefore as a process where individuals link corporate-level instances and individuals with new information from their environment. Whereas Kim and Wilemon (2002) see the beginning of the front end at the point where an opportunity is first considered worthy of further ideation, exploration, and assessment, and ends when a firm decides to invest in the idea. The front end process is difficult to map and design since potentially every new product idea is unique (Massey et al, 2002), and thus boundaries of the front end are unclear. This research focuses on the process that ends with an organisational go/no-go decision and starts with a first, deliberate activity of developing and evaluating a concrete business concept.

**The pre-project innovation phase can be facilitated, but not designed.**

As shown above, the challenge that strategy development and the pre-project innovation phase have to be conducted simultaneously in more radical innovation situations has been recognised by a variety of researchers. To date, there are only a few approaches that facilitate the process of developing strategy and product/service concepts together. Here, the exemplary results of two

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research projects funded by the European Commission, named "*Disrupt-it*" and "*Prosecco*", also EU-funded will be introduced.

In *Disrupt-it*, the impact of disruptive innovation on organisational strategy was explored and methods have been developed that allow organisations to better understand, react to and proactively manage the phenomenon of disruptive innovation (Dvir/Lettice/Thomond, 2004; Thomond, 2005; Thomond/Herzberg/Lettice, 2003). By applying methods of portfolio management, running a disruptive opportunity recognition workshop, and other measures, the risk of being disrupted and the opportunities of developing potentially disruptive innovations can be identified and managed. The portfolio management tools help to guide and facilitate the process and analyse strategic threats. The opportunity workshop relies mainly on creativity techniques (which are discussed in the subsequent section) and specially developed methods of analysis (see Thomond, 2005 for a full discussion).

Another approach to facilitate strategy and product/service co-development was developed in the funded project *Prosecco* (Auernhammer et al, 2002; Auernhammer/Stabe, 2002; Stabe/Wolf, 2003). Here, an opportunity recognition method was developed that relies on future scenarios and strategic analysis of the organisational, market and technology situation. An analysis technique that focuses on involved actors, their needs and context of use helps to identify concepts for further evaluation.

These two examples of applied research show how practitioners can integrate strategy development and concept definition in the pre project phase and thus facilitate their front end activities.

### **Summary of observations.**

The product development process can be regarded as a problem solving process, in particular solving the organisational problem of satisfying customer needs by the means of a new product or service. Especially in the early phases, the ground for successful product development processes and market introduction is being laid. These early phases are a process that cannot be defined by a sharp and general definition, as the problems to solve vary from project to project. With an increasing need for an integrated view and for simultaneous task execution, business, product and project visions and strategies cannot be determined before the process starts but have to be developed simultaneously in conjunction with product and service concepts. Thus, the front end of new product development processes are an integral part of strategy deployment. Because this organisational problem solving process normally deals with problems that have not been solved before, the next section will deal with the topic of creativity.

## 2.4 Creativity in Innovation Processes.

An innovation is a novel idea for commercial exploitation. These ideas have to be developed in an organisational problem solving process in which market needs are matched with products and services. Therefore, innovation is closely related to creative ideas and creativity (Amabile, 1996).

Leonard and Swap (1999:p6) define creativity as a "*process of developing and expressing novel ideas that are likely to be useful*". For Boden (1999), creative ideas have to be novel and valuable. Sternberg and Lubart (1999) define creativity as the ability to produce work that is both novel (meaning original, unexpected) and appropriate (meaning useful and adaptive concerning task constraints). For Holt (2002) and Taylor (1960; 1963) creative ideas have to be novel and worthwhile, which makes the judgment of a creative result determined by subjective criteria. Therefore, Ford (1995) defines creativity as a context specific subjective judgement of the novelty and value of an outcome of an individual's or a collective behaviour. To Amabile (1996, p33), "*creativity is the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced*".

Here, the analogy to the term of innovation becomes clear, as novelty and commercial exploitation can be interpreted as analogous to novelty and usefulness. Unlike in innovation research, the gradual dimension is not as important, because in the innovation context, creativity does not have to be measured, as the results of the creative process count and the question of how to facilitate creativity in innovation processes is important. Thus, **creativity is defined as the generation of useful and novel ideas** (see also Amabile et al, 1996; Stein, 1974; Woodman et al, 1993). Creativity is necessary for innovative results, but it is not sufficient (Amabile et al, 1996). Analogous to innovation, creativity can be seen as a process or as a result. Seen as a result, there are products as results of creative processes (novel and useful products) and creative individuals and organisations that generate creative solutions. First, the process of creativity is going to be addressed and in the second step, focus lies on individuals and organisations.

According to Taylor (1963), Goodman (1995) and Holt (2002), there are four stages in a creative thinking process: preparation, incubation, illumination and verification. In the first step, the problem has to be understood and the necessary information has to be collected, the problem solver has to seek deep involvement, process and provide information, define and reformulate the problem. The incubation phase is a subconscious process, where information is linked and processed. Illumination is the generation or synthesis of an idea on the conscious level, a surprising or "*eureka*" moment. In the verification phase, the idea is tested for its usefulness as a problem-solution. A closer look at the process models described in the previous section shows similarities. First, the problems are defined and then in different stages evaluated, redefined and further developed.

In the creativity context, Leonard and Swap (1999) define innovation as a synthesis of knowledge in novel and relevant, thus valued new products, services or processes. Therefore, innovation processes are a special type of creative processes. Their adapted model of a creative process consists of preparation, innovation opportunity seeking, options generation, and incubation. In the final stage, the selection of options converges the whole process again. Creative problem solving is mostly based on heuristics rather than on algorithms (Amabile, 1996), and therefore the aim of planning in detail the pre-project innovation phase is not a realistic one.

There are several theories about how creative solutions arise (Holt, 2002). There is the achievement theory, that says that creative behaviour is born out of a desire to accomplish results. The theory of necessity suggests that creative behaviour is motivated by a strong need, while chance theory assumes that creative ideas result from coincidence. Theories of the genius and intelligence theory assume that creativity belongs to a limited number of people or that it depends on intelligent thinking.

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The psychoanalytical theory suggests that creative ideas are the result of uncontrolled thinking processes that are non-rational in their nature.

Probably all of these theories contain part of the whole truth, as the construct of creativity is hard to measure and values of variables are subjective. In an extensive review of the literature about creativity, Andriopoulos (2003) states that early theorists focused on personality dimensions, like Michael, 1979 and MacKinnon (1960, 1962). Later on, the organisational environment was researched for its effect on creativity, conducted by authors like Amabile et al (1996) or Cummings and Oldham (1997). Amabile et al (1996) see the foundations of innovation in creative project work by teams of individuals and assume that the social environment can influence the level and frequency of creative behaviour. The following table gives an overview about the factors that influence creative performance as developed by Amabile et al (1996):

Components of creative performance.		
Domain-relevant skills	Creativity- relevant skills	Task motivation
Knowledge about the domain.	Appropriate cognitive style.	Attitudes towards the task.
Technical skills required.	Implicit or explicit knowledge of heuristics for generating novel ideas.	Perception of own motivation for undertaking the task.
Special domain-relevant talent	Conducive work style.	<ul style="list-style-type: none"> <li>Initial level of intrinsic motivation toward the task.</li> </ul>
<ul style="list-style-type: none"> <li>Innate cognitive abilities.</li> <li>Innate perceptual and motor skills.</li> <li>Formal and informal education.</li> </ul>	<ul style="list-style-type: none"> <li>Depends on training.</li> <li>Experience in idea generation.</li> <li>Personality characteristics.</li> </ul>	<ul style="list-style-type: none"> <li>Presence or absence of salient extrinsic constraints.</li> <li>Individual ability to cognitively minimise extrinsic constraints.</li> </ul>

Figure 8: Components of creative performance, Amabile et al, 1996.

As the table shows, organisation and individual capabilities and roles play a major role in the innovation process. Thus, the next section focuses on methods to enhance creativity.

**Creativity techniques can be described as problem solving heuristics.**

Special capabilities also comprise dealing with creativity and applying creativity techniques (Amabile, 1996: “heuristics”) that allow novel ideas to be developed to solve a problem. Schlicksupp (1999), Higgins (1994) or Holt (2002) present collections of methods supporting the process of preparation, incubation, illumination and verification. The creativity process is a psychological process, and thus methods cannot be clearly sorted step by step but only support or lead through the process. Holt (2002) distinguishes methods of the following categories: free association, analytical thinking, forced relationship, progressive abstraction and eclectic thinking. Free association techniques work with associations to statements, pictures, words and others. A very well known example is Osborn's (1953) Brainstorming technique, where in a group as many ideas as possible have to be collected,

no critique is allowed and ideas of other team members explicitly should be taken on and further developed. Visualisation techniques, like Buzan's (1983) Mind mapping can support the process of association and cognitive mapping of information. Analytic thinking methods like morphological analysis reveal all possible combinations and solutions of idea components by a systematic breakdown of the problem. By applying forced relationships techniques, features and alternatives are combined that normally would not be associated in order to find out new possible combinations. In progressive abstraction, the questions of "why" and "what" are asked stepwise repeatedly in order to find out reasons and problems behind the problem to be solved. Eclectic thinking methods combine analytical and associative elements in order to solve complex problems. TRIZ is an example for this type of heuristics. It provides templates for structured technical problem solving (Terninko et al, 1996). Goldenberg and Mazursky (2002) base product development techniques on TRIZ and provide a heuristic that facilitates the analysis and solution of product development problems.

This list of techniques and further developments of the heuristics cannot be complete. The overview should explain that creativity can be supported by techniques and thus, a combination of these facilitating elements can lead through the pre project innovation phase.

## **2.5 Organisational Factors for Innovation Processes.**

In this section the central question is, what frame an organisation has to offer in order to enable successful innovation processes. As developed in the earlier sections, an organisation has to enable communication, creativity, offer project management support and provide help to overcome internal barriers to innovation.

### **The organisational structure enables innovation processes.**

Innovation is a critical factor for the survival and growth of an organisation (Twiss, 1974) and therefore it is a purpose that needs a specifically designed organisation (Galbraith, 1982). Although the business environments of organisations have changed significantly over the past decades, their innovation processes have not changed (Tidd, 2001; Wind/Mahajan, 1997). As the problem solving process within the organisations and their business environments in terms of sources of innovation and market and technological opportunities are very individual, there is unlikely to be one single best way to manage and organise innovation (Tidd, 1997). Thus, research on the organisation of innovation processes is still very much focused on success factors, but it is not possible to develop prescriptive recommendations, as shown in the introduction of this chapter. To van de Ven (1986), innovation management is characterised by four problems: a human problem of managing attention, a process problem of managing ideas, a structural problem and a strategic problem. The process problem and the strategic problem have been discussed. In the following it will be shown, how organisational factors help to facilitate innovation processes and thus the problem of managing attention and the structural problem will be analysed.

### **Organisational roles support the conduction of innovation projects.**

In order to overcome organisational barriers and to prepare the ground for project management, models have been developed to describe necessary individuals and roles for successful innovation processes. On the basis of Witte (1973), Hauschildt and Kirchmann (2001) distinguish three main characters who are necessary in innovation and adoption processes: technology promoters, process promoters and power promoters. Due to different interpretations in German and Anglo-American communities, they use the term promoters instead of the more common champion. Technology promoters are specialists in their technology field, know the relevant technologies and their capabilities. Process promoters facilitate the communication processes within the organisation, and power promoters have an outstanding influential position. All of these three types of individuals use their specific power resources in order to overcome organisational barriers to the adoption of innovation. Hauschildt and Kirchmann assume that all three types of promoters are necessary for a successful innovation process.

A slightly different approach is developed by Roberts and Fusfeld (1981), who distinguish roles that need to be played by individuals in the process. They distinguish six phases of the innovation process, where different actors take different roles with different emphasis and tasks. In the phases of pre-project, development of project possibilities, the project initiation, the project execution, its outcome evaluation and the project transfer, different roles have to be taken by project participants. The idea generator is the product and technology specialist, the entrepreneur or champion always seeks to find new project ideas and provides contacts, and the project leader is responsible for conducting the project. Gatekeepers are individuals who link external information with internal information needs. As information brokers, they are contact persons and representatives to the outside (see also Allen, 1977). The sponsors or coaches can be compared to Witte's power

promoters. They are decision makers and give top management support to the project. Roberts and Fufeld (1981) assume that an innovation project is successful, when the roles are taken by the right individuals. Both models assume a technology push concept that does not imply customers as sources for innovation, and they are very much related to the political and communication process rather than to the conceptual problem solving process. Therefore organisational roles and leadership are not further considered in this research (see Howell/Higgins (1990) for a discussion of role and emergence of champions for innovation).

### **Communication is a critical factor in innovation processes.**

Predominantly addressed by researchers coming from Brown and Eisenhardt's (1995) communication web perspective, the issue of communication is researched in terms of roles and characteristics of people involved in the innovation process. In his basic work "*Managing the flow of technology*", Allen (1977) analysed communication in innovation processes from several perspectives: the influence of building architecture, the role of formal and informal communication, and communication patterns in science and technology. Reid and de Brentani (2004) further develop this approach and define interfaces between individuals, the organisation and the environment through boundary spanners, gatekeepers and decision-makers who take care of boundary, gate keeping and project interfaces. With this approach, they build a bridge from the role models (Roberts and Fufeld, 1981) and communication issues within the organisation.

The communication issue is closely tied to the issue of creativity, as creative ability lies within individuals who have to co-operate in innovation processes (O'Connor/Rice, 2001) and successful implementation depends on individuals or teams having good ideas and developing it beyond the initial stage (Amabile et al, 1996).

### **Organisations need to encourage creativity.**

According to O'Connor and Rice (2001), creative ability lies within individuals, and the degree of creativity varies across individuals. The pre-project problem solving process is a creative act and it is organisational measures that enable individuals to act creatively by motivating, developing and directing their creativity. The question is, what an organisation can offer to enable creative opportunity recognition.

In organisations, creativity has to be encouraged. Creative people need autonomy, sufficient resources, time pressure and the absence of organisational impediments (Amabile et al, 1996; 1988). Creativity can be encouraged by the organisation itself, supervisory instances and the workgroup. External pressures should be such that the individuals feel challenged but not overstrained with the problem to solve. Encouragement is not the same as motivation, as creativity can only be unleashed and intrinsic motivation is the most important factor for individuals to develop creative ideas (Amabile, 1996). People have to be interested, feel enjoyment, satisfaction and to have a challenge with the problem to solve. Thus, individuals and task characteristics have to be matched. Further, autonomy is important for creative problem solvers as they normally search their problems themselves in defined boundaries. According to Andriopoulos (2001), organisational creativity depends on leadership style, organisational climate, organisational culture, resources and skills, and the structure and systems of an organisation. Leadership style should be democratic and participative, creative work should be recognised and valued (Amabile, 1988; Nyström, 1979). The organisational culture should offer an open flow of communication, and allow risk-taking and trust. Individuals should be encouraged to participate in the processes and have freedom of expression. The structures and systems should offer long-term orientation, a flat structure and offer rewards for creative solutions (Andriopoulos, 2001).

## The Pre-project Innovation Phase – a Review of the Literature.

Andriopoulos (2003) describes the management of creativity in organisations as a paradox between supporting employee's passions and achieving financial goals; challenging employees, and building their confidence; encouraging individual initiative, and maintaining a shared vision, encouraging diversity, and building cohesive teams; learning from the past, and seeking new areas of knowledge; taking incremental risks, and breaking new ground. This description of mixed messages illustrates the area of conflict. These paradoxes are addressed by organisations with one of the two approaches: either by formal process design or by company-wide culture (Khurana/Rosenthal, 1998), by working on the levels of business vision, technical feasibility, customer focus, schedule, resources, and coordination. According to Galbraith (1982), the formal process can be designed by the following measures: the structure is defined by roles, task differentiation and reservations, processes are the planning and funding routines and the conceptual processes of getting ideas, blending ideas and transitioning them into project programs. Reward systems are influenced by individual opportunities, autonomy, promotion and recognition and special compensation. The individuals involved have to be carefully selected and self-selection has to be enabled. They have to be trained and developed. Galbraith also stresses the difference to operating organisations, which need to be designed differently.

On the team level, Tushman and Nadler (1986) suggest selecting people with diverse expertise, good problem solving and team building skills. Kim and Wilemon (2002) suggest appointing a skilled team or individual to lead the process.

### **Designing the organisation is a success factor for innovation projects.**

To summarise, the design of pre-project processes is based on success factors as described above, and organisational arrangements for this creative problem solving process have to be developed individually for each organisation. In the sections above, the peculiarities of pre-project processes in new product development have been described and discussed on a process and organisational level. As the new product strategy has to be pursued within an organisation in a creative problem solving process, in the next step the results will be summarised.



## 2.6 Summary and Definition of Research Objectives.

In this chapter, the problem of managing innovation was introduced. Innovation emerges by commercial exploitation of a novel concept and thus is critical to organisational success, competitive strength and value creation. Organisations innovate because new markets promise monopoly profits or the chance of disappearing from a highly competitive environment into oligopolistic structures.

This research focuses on innovations that create value for customers, meaning new products and services or processes that have direct impact on the product's or service's value creation. As innovations that are new to the organisation and aimed for relatively young markets challenge the concept development from a methodological perspective, these are central for this research project.

Research on the processes of new product development, especially the early phases have been explored. Here, research suggests that especially in competitive environments with highly innovative concepts and time pressures strategy, new product strategy and new product development projects are developed jointly in a simultaneous problem solving process. In these early phases, creativity is essential for problem solving processes. Then, organisational factors have been analysed that facilitate innovation by enabling communication, creativity and overcoming organisational barriers to innovation adoption. The following figure shows, how strategy, the new product concept and organisation interrelate.

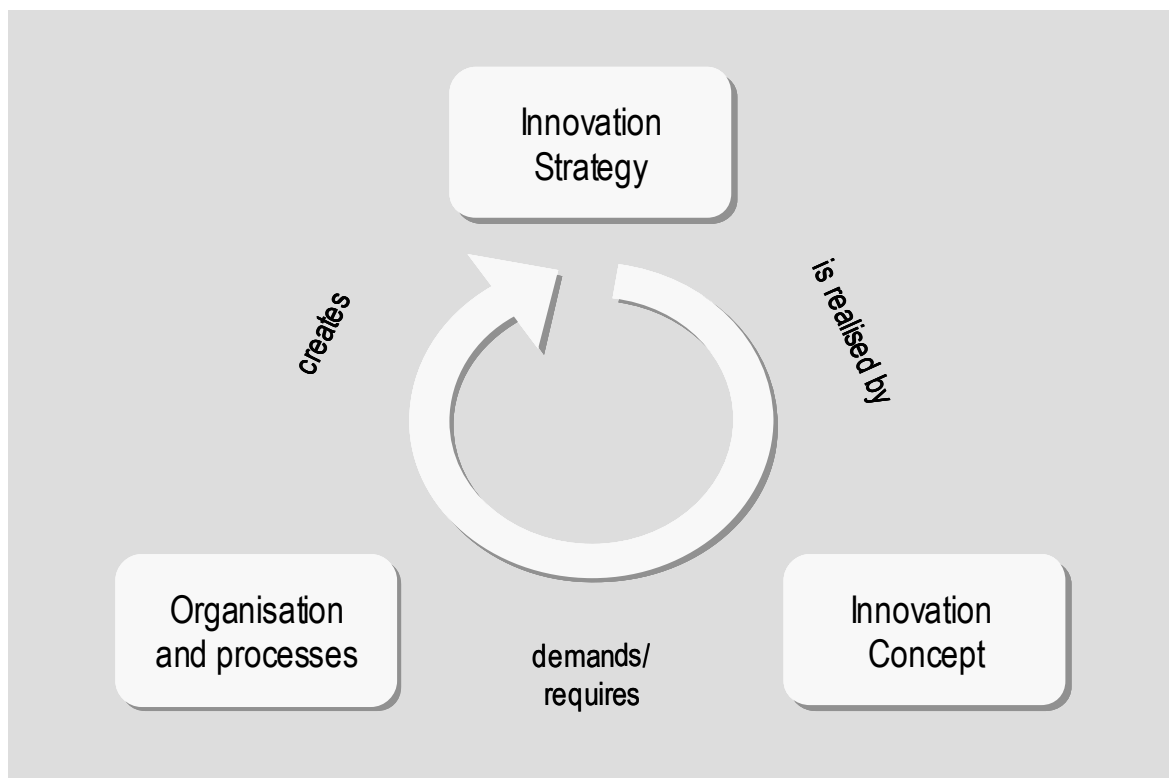


Figure 9: The interrelation between innovation strategy, concept generation and organisation, developed by the author.

The concept for a new product or service is developed in order to pursue an organisational strategy, in particular the new product strategy. The concept definition process demands enabling factors of the innovating organisation which itself deploys its strategy. With more and more overlapping processes, the way round this circle shortens, and interrelation between these factors further increases. Research has shown that the link from strategy to concept development is crucial for

## The Pre-project Innovation Phase – a Review of the Literature.

product development success. This link from strategy to the conceptual level has been approached by creativity techniques that are conceived to help generate problem-solutions out of a strategic problem definition. Another approach are method sets that help to facilitate the strategy-concept link.

However, to date there is no theory explaining the connection between the strategic situation of an organisation and requirements for applied methods in the pre project innovation phase. Thus, the question of how to link strategy deployment and concept development has been explored already, but the question of whether specific strategic situations lead to specific method requirements has not been analysed. **Therefore, the refined, overall objective of this research project is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations.**

On the basis of this research objective, in the next chapter an appropriate research strategy will be developed. In the subsequent chapter, the basic theoretical frame will be further evaluated. Here, the interrelation of strategy and organisation, the topic of problem solving and decision-making methods, and the contingency view as a basis for a situational analysis of methods in strategic situations will be introduced. On the basis of an analysis of contingency based research in innovation management, shortcomings in innovation research will be explained. On this basis, a theoretical framework will be developed and empirically evaluated in order to develop a theory of method selection in specific strategic situations.

### 3 Developing Theory and Research Strategy.

*Chapter aims: In this chapter, I will provide an overview on theory, theory development methodology and criteria for theory evaluation. At the end of this chapter, I will develop an appropriate strategy for the research project.*

In the previous chapter, the central research objective has been described. It has been shown that there is no theory on a conceptual level on pre-project innovation processes yet and that there is a need for one to be developed.

In this chapter, an appropriate research strategy and criteria for the discussion of research results will be developed. First, the concept of theory and theoretical contributions will be described and defined. Then the process of developing theory and the criteria for theory evaluation will be outlined. Based on these criteria, the research objectives will be analysed in order to choose an appropriate approach to methods for theory development.

It will be shown that the research will be rather qualitative than quantitative, as it is theory developing rather than testing. However, as the perspective on the research objects (innovating organisations) is new, but the research topic itself is not, the approach will start with a deductive logic. In order to validate the developed insights and propositions, an inductive, case-based approach will be used to develop hypotheses about the selection of methods for the pre-project innovation phase in different strategic situations.

The aim of this chapter is not to develop research methodology, but rather to give a summary of existing approaches that serves to give a structure for developing an appropriate methodological approach to the research objectives.

### 3.1 Theory as Structured, Explanatory, Abstract Knowledge.

The objectives of research can be to explore and to describe a research problem, to explain the interdependence of components within the research problem or to predict whether an object is affected by the research problem and therefore what the effects might be for the affected object (Hussey/Hussey, 1997). Thus, the purpose of research is to work towards generating a theory, that gives explanations to questions of why, which implies that the questions of what and how are also answered (Whetten, 2002, 1989; Bacharach, 1989; Kaplan, 1964; Dubin, 1978; Mohr, 1982, Sutton/Staw, 1995). Whetten (2002) distinguishes between scholarly description and scholarly explanation, where the latter is necessary to constitute a theoretical contribution.<sup>12</sup> However, neither the concept nor the term of theory are used in a consensual way (Sutton/Staw, 1995, Runkel/Runkel, 1984; Weick, 1989).

For DiMaggio (1995), theories are focussed and comprehensive covering laws. However Bacharach (1989, p496) describes them as a "*statement of relations among concepts within a set of boundary assumptions and constraints*". Sutherland (1975, p9), defines theory as "*an ordered set of assertions about a generic behavior or structure assumed to hold throughout a significantly broad range of specific instances*". Thus to conclude, **a theory provides explanatory structured knowledge about a broad range of research objects on an abstract level**. This definition helps to describe the concept of a theory, although it is still not clear how to develop a good theory. The next paragraph illustrates this problem.

To Weick (1989), theory is rather a dimension than a category. Similarly Runkel/Runkel (1984) see it as a continuum rather than a dichotomy, with the result that researchers hesitate to call their contribution a theory. As it is not always entirely clear whether a contribution is a theory or not, it could be a stage of theorising (Weick, 1995) and therefore a preliminary result on the way towards theory. According to Merton (1967), the word theory is used in too many contexts, without providing actual theory and therefore the term rather obscures than provides understanding. Further, it is not always the case that developing theory is the desired outcome of research activities (Sutton/Staw, 1995).

This illustrates that the criteria of the definitions above are necessary but not sufficient to describe the concept. To further approximate and to attain a better understanding of theory, in the next steps it has to be made clear what the components of a theory actually are and which attributes constitute the quality of a theory.

A theory consists of variables, constructs, propositions and hypotheses that describe one or more research objects. While variables are observable entities being capable to assume a value (Schwab, 1980), a construct is not observable itself, but can be described by an observable entity (Bacharach, 1989, Kaplan, 1964). To describe and explain constructs and the interdependence of variables, Pettigrew (1990, 1992) distinguishes in the context of organisational change management research three kinds of variables. Outer and inner context variables describe the environment and inner circumstances that influence the research object, content variables describe the actual research phenomena, and outcome variables describe explained changes of the phenomenon.

While variables and constructs describe the research phenomena, propositions and hypotheses form the explanatory part of a theory. Propositions and hypotheses state relationships between variables

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<sup>12</sup> This does not affect the fact that the testing of a theory may also be an objective for research, but in the last consequence, a theory is only tested to either be falsified or to be confirmed and therefore again to confirm or reject scholarly explanation.

and constructs. The main difference is, that hypotheses are falsifiable and can be tested and therefore require concrete measures as an outcome, while propositions only state the relations among constructs and variables (Bacharach, 1989; Whetten, 1989).

In order to describe what makes a good theory, it has to be made clear what the purpose of a theory is, besides describing and explaining variables and concepts. According to Bacharach (1989), the purpose of a theory is twofold: to organise knowledge and to communicate knowledge. According to Merton (1968), this can be achieved by different types of theories, specifically by minor working hypotheses that are necessary for day to day research, by all inclusive unified theories, and in between by middle range theories, that are solutions to problems that contain a limited number of assumptions and more specificity in the problem statement (Weick, 1989).

Keeping up the distinction of organising and communicating knowledge, theories have to be compatible to certain quality standards and further, they have to enable communication among researchers. Therefore, theory may not prevent, but should rather encourage communication. First of all, in order to encourage communication among researchers, a theory has to be relevant, plausible, attractive and interesting (Weick, 1989). Weick even goes so far as to say that interest would be a substitute for validation of the theory.

For Bacharach (1989), a theory has to be falsifiable and have utility (see also Popper, 1959; Nagel, 1961; Hempel, 1965). As described above, only if a theory explains and predicts, is it of use. More important is that a theory can be falsified, because only this makes it possible for a theory to be further refined and developed.<sup>13</sup> In order to make a theory falsifiable, the preconditions under which the explanations are made have to be overt to set boundaries for generalisation (Dubin, 1978; Bacharach, 1989). For Sutton/Staw (1995), it is not entirely clear whether a theory is stronger when it is interesting or whether falsifiability is a prerequisite. This contradiction shows, that theory always lies in an area of conflict that is described by Weick (1989) the following way: "*[...] a good theory is a plausible theory, and a theory is judged to be more plausible and of higher quality if it is interesting rather than obvious, irrelevant or absurd, obvious in novel ways, a source of unexpected connections, high in narrative rationality, aesthetically pleasing, or correspondent with presumed realities.*" (Weick, 1989, p517).

At this point, the concept of theory and the contradictory dilemma of developing a good theory have been illustrated. As the criteria are still not sufficient to explain and prescribe the quality of theory, the steps for developing a theory will be discussed in the next section.

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<sup>13</sup> statements that cannot be falsified, for example para-psychological or religious assumptions cannot be verified or falsified. Therefore, they are inappropriate for theory discussion.

### 3.2 Developing Theory –The Process of Theorising.

A theory consists of constructs, variables and propositions or hypotheses. Based on this, the process of developing a theory can be described by the following five-step process, which has been developed by the author as a synthesis of section 3.1.

- First, the research objectives have to be set, the research question or problem has to be clarified in order to clearly define the research objects.
- In the second step, the key constructs and variables have to be identified and described that describe and influence the research objects.
- In the third step, relations between variables and constructs have to be identified and described.
- Out of these identified relationships, in the fourth step, propositions or hypotheses have to be developed and explained in the context of the research problem.
- In the final step, the hypotheses and propositions have to be reviewed for quality, and the theory needs to be refined.

In order to acquire the knowledge, researchers use prior literature and/or empirical data. The knowledge (variables, constructs, relationships) is organised by lists, typologies or models. This also facilitates communication of the developed outcomes. While literature can deliver structures, strategies, consequences and results of prior research (Strauss/Corbin, 1998), empirical data allows direct observations of variables in the very special context of the defined research problem (a problem, a question or an observed anomaly, Weick (1989)). According to Chia (2002), the variables and constructs are identified, labelled and causally linked to other variables and constructs in order to form a coherent system of explanation. Knowledge is therefore produced by a process of selective abstraction, identification and recombination. In order to develop a more interesting, coherent and plausible theory, researchers collect more empirical data than necessary for sheer speculation and the theory will normally contain more than one hypothesis (Runkel/Runkel, 1984).

However, the fact that a typology or data alone do not make a theory is illustrated by Bacharach's (1989:496) analogy: "*Just as a collection of words does not make a sentence, a collection of constructs and variables does not necessarily make a theory*". As theory has the purpose of organising and communicating knowledge, data and lists of variables, literature and references, models and diagrams can only illustrate and organise the actual theory and therefore have to be interpreted and explained in the context of the developed theory to enable other researchers to understand what the researcher means (Sutton/Staw, 1995; Whetten, 1989, Weick, 1989; Kaplan 1964).

To develop good theory, the knowledge has to be acquired objectively and the way of acquisition must be repeatable (reliable). The research has to be relevant, generalisable and significant, which means not coincidentally relevant to the observed group of research objects. The variables and constructs have to be linked consistently, precisely and comprehensively. Further, the constructs, variables and hypotheses have to give a valid image of the observed reality that can be verified (Hussey/Hussey, 1997; Yin, 2003; Strauss/Corbin, 1998; Miles/Huberman, 1994). Each of these principles will now be explained.

**Objectivity and reliability enable the reproduction of a theory.**

Objectivity is a principle that is necessary to deliver unbiased results derived from the data collected. To achieve objective results, they need to be independently reproducible by different researchers (James/Vinnicombe, 2002). This means that the researcher should draw conclusions from the research findings and not from his subjective point of view. In this context, the Austrian social constructionist Friedrich von Foerster stated once that objectivity is the assumption of a non-existing researcher (Foerster/Porksen, 1998), as a research problem often is tied very much to the personal interests of a researcher (James/Vinnicombe, 2002). Reliability of measurement means that the repeated collection of data always generates the same or very similar data (Hussey/Hussey, 1997). Objectivity and reliability allow a research project to deliver repeatable and therefore comprehensible results. To keep absolute objectivity is a challenge, as research in different times can be influenced by values and assumptions that are only implicitly influencing the theory (Dubin, 1969; Bacharach, 1989). To summarise, all research is subjective by nature, as the researcher becomes part of the observed system. However, an appropriate research design can help to eliminate some of the researcher's bias.

**Relevance, generalisability and significance make a theory applicable.**

As shown above, the research problem has to be of relevance to the research community or to be of interest to the recipients. In this context, the term relevance has the different meaning of whether the research problem or the observed phenomenon is of relevance to the research object. It is necessary, that the research problem does make a difference. Further, the sufficient conditions are that the observed difference has to be generalisable to the whole observed population of research objects and that the observed difference is not only coincidentally observable (Hussey/Hussey, 1997; Babbie, 2001). In order to be able to generalise, the boundaries for generalisation have to be made overt, like space, time, implicit assumptions and other conditions (Dubin, 1978; Bacharach, 1989).<sup>14</sup>

**Comprehensiveness, consistency and precision enable theory discussion.**

In order to make a research outcome repeatable and understandable, the research problem has to be explored comprehensively, which means that all relevant variables and constructs have to be precisely described and explained (Dubin, 1978). Comprehensiveness and precision can be influenced by defining the research problem more precisely and by a broader exploration and understanding of the problem. Therefore it is important to exclude variables that add no further descriptive and explanatory value. Both alternatives help to identify relevant and irrelevant factors to reach consistency and precision. However, the identification and exclusion of variables in open systems is not trivial, as in social systems units, and their relations are not overt and change over time (Tsang/Kwan, 1999; Harré/Second, 1972).

**Validity and verification make sure that theory represents reality.**

One of the most important factors for good theory is validity. First, the chosen set of variables to describe a construct have to describe exclusively this construct and not any other one (construct or face validity). Further, internal validity depends on whether the explained relationships are really the ones described and not other, different ones. External validity is whether the observed constructs

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<sup>14</sup> Bacharach (1989) states that if a theory is to be properly used or tested, the theorist's implicit assumptions which form the boundaries of the theory must be understood. He illustrates this with an interesting example about the construct of power. According to Parsons (1962), power is the mobilization of resources, and thus not a zero-sum game. Contrarily, Mills (1956) sees power as the control of resources and thus it has to be a zero-sum game. Mills' conclusion bases on the assumption that resources are finite. For this research project, this means that these assumed contradictions might be founded in assumptions and therefore the assumptions or contingencies have to be disclosed that lead to conclusions.

## Developing Theory and Research Strategy.

and research objects represent the research problem and the population of research objects (Yin, 2003). This validity of variables, constructs and hypotheses has to be validated with the population and the research problem. The problem of validating often leads to development of theory that is easy to validate for the price of usefulness (Lindblom, 1987). Validity affects generalisability and plausibility of the developed theory. The research object of open social systems like organisations even aggravates the problem, which makes the quality of the definition of the research problem even more important. Social systems are open due to two reasons: due to human interaction, the configuration of the system changes and thus the extrinsic conditions of the system. Further, learning of human actors changes the intrinsic conditions, which means that actors might not necessarily behave the same way they as did before. This implies also, that research in the social sciences is more explanatory than predictive. This aggravates the problem of testing theory (Sayer, 1992; Tsang/Kwan, 1999).

A measure to achieve validity is triangulation of data, investigator, methodology, and theory. A phenomenon should be analysed by more than one perspective to ensure that it is well understood and measured correctly (Hussey/Hussey, 1997; Yin, 2003).

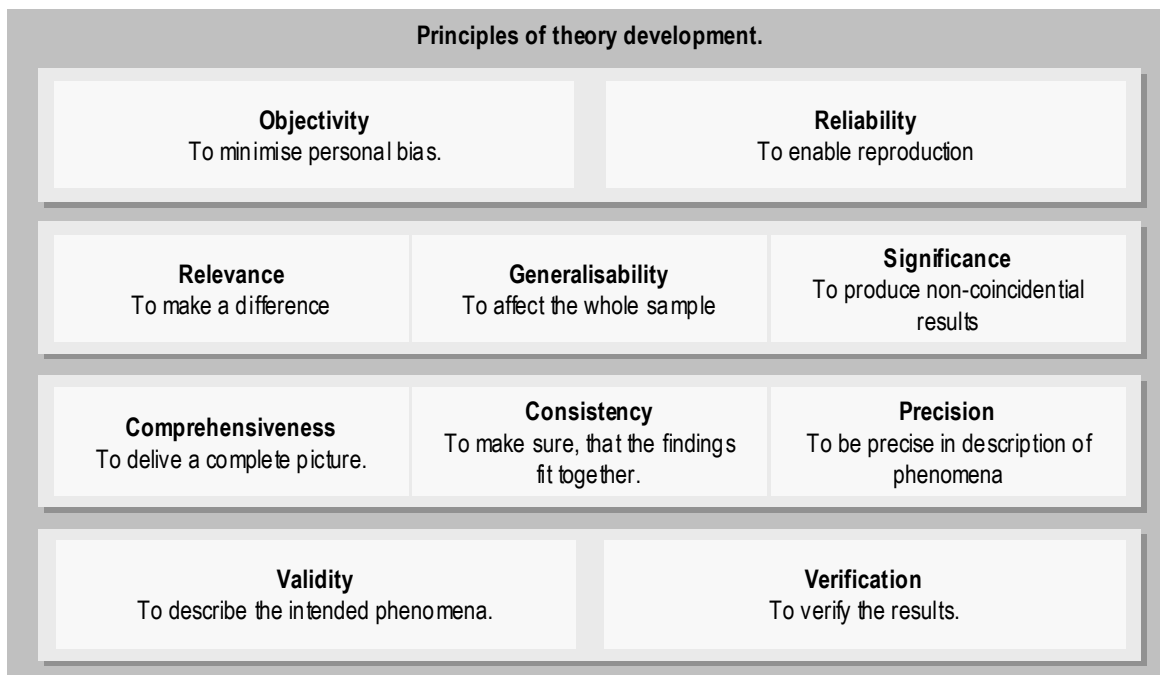


Figure 10: Principles of theory development, compiled by the author.

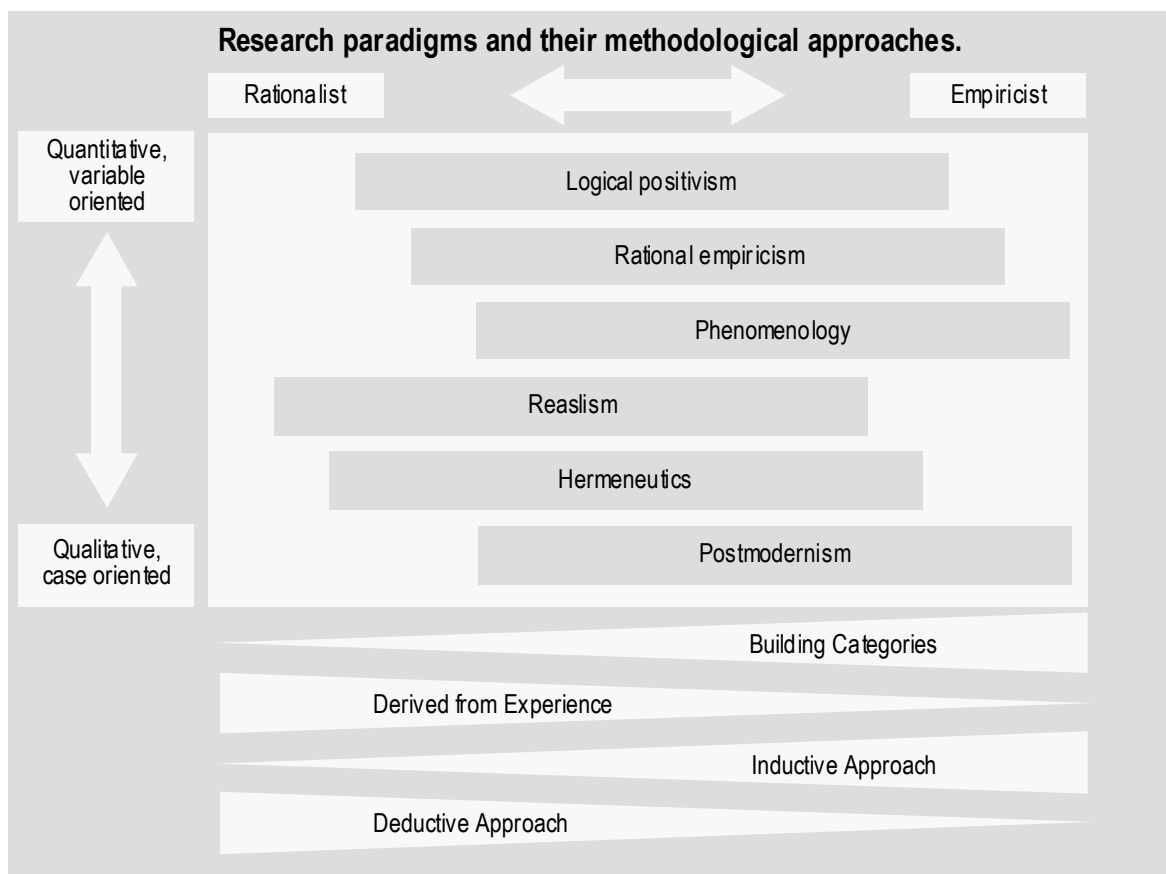
To summarise, it is not sufficient just to describe and to explain how to develop good theory, it is important to consider whether the explanations make reproducible sense. To achieve this, it is a question of how to actually acquire new knowledge. According to Weick (1989), the quality of theory varies as a function of the accuracy and detail present in the problem statement that triggers theory building and the number of and diversity of selection criteria used to test the conjectures. This requires rigour in selecting and applying appropriate research methods. Bourgeois (1979) suggests a theory development process, by first partitioning the topic under investigation, second selecting the method of theory construction, reviewing the literature, constructing of theory-induction from the empirical base, then extending the theory-deduction into propositions, a metaphysical elaboration, and a conclusion. Unfortunately, theorizing is not a linear problem-solving process (Weick, 1989). This is underlined by Diesing (1971), who states that these proceedings are not mechanistic nor do



they lead automatically to results like algorithms. They have to be applied flexibly, according to the circumstances, accepting that in every step alternatives have to be possible.

**The methodological approach is determined by the underlying research paradigm.**

The two philosophical disciplines of ontology and epistemology deal with the questions of the nature of reality, what is considered as real (ontology) and of how and what is possible to know (epistemology). Depending on the viewpoint on how to develop new knowledge, different paradigms evolve that prescribe how to conduct research and to develop theoretical contributions. On the two ends of the continuum, there are rationalist and empiricist paradigms (James, 1909/1996). While empiricist paradigms describe and explain reality from experience, rationalist paradigms explain in universalistic and idealised, logic categories (Chia, 2002). While empiricists follow a more inductive logic, the rationalist paradigms follow a more deductive logic. Out of these two ways of generating insight, several paradigms have evolved, that are either bound to more quantitative and descriptive methods (logical positivism and rational empiricism), or to more qualitative and insight-generating methods (like phenomenology) and some paradigms lying in between (like realism, hermeneutics, and postmodernism). The following illustration shows different paradigms and resulting methods.



**Figure 11: Research paradigms and their methodological approach, developed by the author, processed from Chia (2002) and Ragin (1987).**

The illustration shows that there are several different approaches to develop knowledge and theory. However, they probably have not evolved before researchers started to work, but rather ex post when different methods and results could be observed and categorised. This might be due to the fact that research is influenced by zeitgeist (Dubin, 1969) and the personal preferences of a researcher (James/Vinnicombe, 2002). Further, the method should not determine the problem, but rather the

### Developing Theory and Research Strategy.

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research objective should determine the selected and applied method. Thus, it is necessary to overcome existing 'paradigm wars' and focus on the aimed outcomes of research work (Johnson/Harris, 2002; McKinley/Mone, 1998; Weick, 1999; Calas/Smircich, 1999).

Ragin (1987) distinguishes variable-oriented and case-oriented research. While variable-oriented research seeks to apply statistical techniques in order to derive broad generalisations, case-oriented research seeks to apply multiple methods to triangulate and understand deviations of cases. Quantitative and therefore variable-oriented research is especially appropriate to testing theory, while qualitative research methods allow the field to be explored and theory to be developed (Johnson/Harris, 2002).

As the objective of this project is to develop theory in a field that has been explored but not from this perspective yet, accordingly the methods will be more of qualitative than quantitative nature. In the next section, an appropriate, qualitative research strategy will be developed.

### **3.3 Applied Research Strategy and Proceeding.**

As described in the beginning of section 3.3, this research will follow a five-step process.

First, the research objectives have to be set, the research question or problem has to be made clear in order to define clearly the research objects. In the second step, the key constructs and variables have to be identified that describe and influence the research objects. Then, key constructs and variables have to be described. In the fourth step, relations among variables and constructs have to be identified and described. Out of these identified relationships, in the fifth step, propositions or hypotheses have to be developed and explained in the context of the research problem.

#### **Step 1: Setting the research objectives.**

The research objectives have been described in the two previous chapters, therefore in this section only the kind of objectives and their consequences for this project are discussed.

Hussey/Hussey (1997) distinguish the two research types of basic research and applied research. While applied research aims to provide practical applications for practitioners from theory, basic research aims to provide basic, theoretical insights that allow further investigation and development of knowledge. As to date, the conceptual perspective to pre-project innovation research is new and it further promises to provide a new way to access the topic, the research objective appears to be of a basic type. On the other hand, the results of this research will allow more practically applicable insights and recommendations to practitioners to be developed, which makes it a more applied research type. Therefore, the research objective aims to provide a basic, theoretical framework for further applied research which makes it a research type between the two ends of the continuum. Also, the research aims to develop theory rather than to test theory. This makes a qualitative approach more appropriate.

#### **Step 2: Identification and description of key constructs and variables that influence the research objects.**

As seen in chapter two, research on the pre-project innovation phase is not entirely new and there is already a vast range of literature containing a large number of existing empirical and theoretical insights into the topic. Therefore, to gain access to the key concepts, they are going to be accessed using existing theory, which implies a deductive approach from a rationalist point of view.

In order to identify key constructs and variables from existing theory, the conceptual perspective on innovation pre-project processes has to be distinguished from the strategic and the organisational perspective. Further, an understanding of the pre-project phase as a problem solving process has to be developed. Contingency theory offers an approach to match an organisational task with its structure. As a result, the concept of methods in problem-solving processes will be developed and the influencing variables of organisational strategy and the organisational environment are going to be described. Further, variables that influence the selection of methods, but that are irrelevant to the research topic, are excluded in order to develop a precise understanding and to understand the boundaries and preconditions for generalisation of later results.

**Step 3: Identification of relations among variables and constructs.**

On the basis of the identified key constructs, the description of variables will be further refined by setting them in relation to each other. The resulting theoretical framework allows propositions to be developed about the appropriate selection of methods in different organisational situations.

**Steps 4 and 5: Development of hypotheses and review of the developed theory.**

Up to this point, the research logic has been deductive and more rationalist. From this point on, the four situations will be taken as a basis for choosing representative cases in order to validate the concepts of pre-project activities and to find out differences between them in different strategic situations. This can be seen as an inductive validation, as the results will be discussed from a methodological and from a content perspective together with the developed propositions. The objective is to conclude with hypotheses that describe the selection of methods for the innovation pre-project phase in different strategic situations. On the basis of the theoretical framework, requirements for methods selection will be derived, in order to make the operationalised theory applicable and testable. A quantitative testing of the theory is not in the scope of this research.

To summarise, in the final step, the propositions and the theoretical framework behind them will be evaluated in order to derive hypotheses about the selection of methods in innovation pre-project phases. The evaluation will be pursued by conducting case study research, which helps to identify contradictions or maldefined constructs better than quantitative approaches.

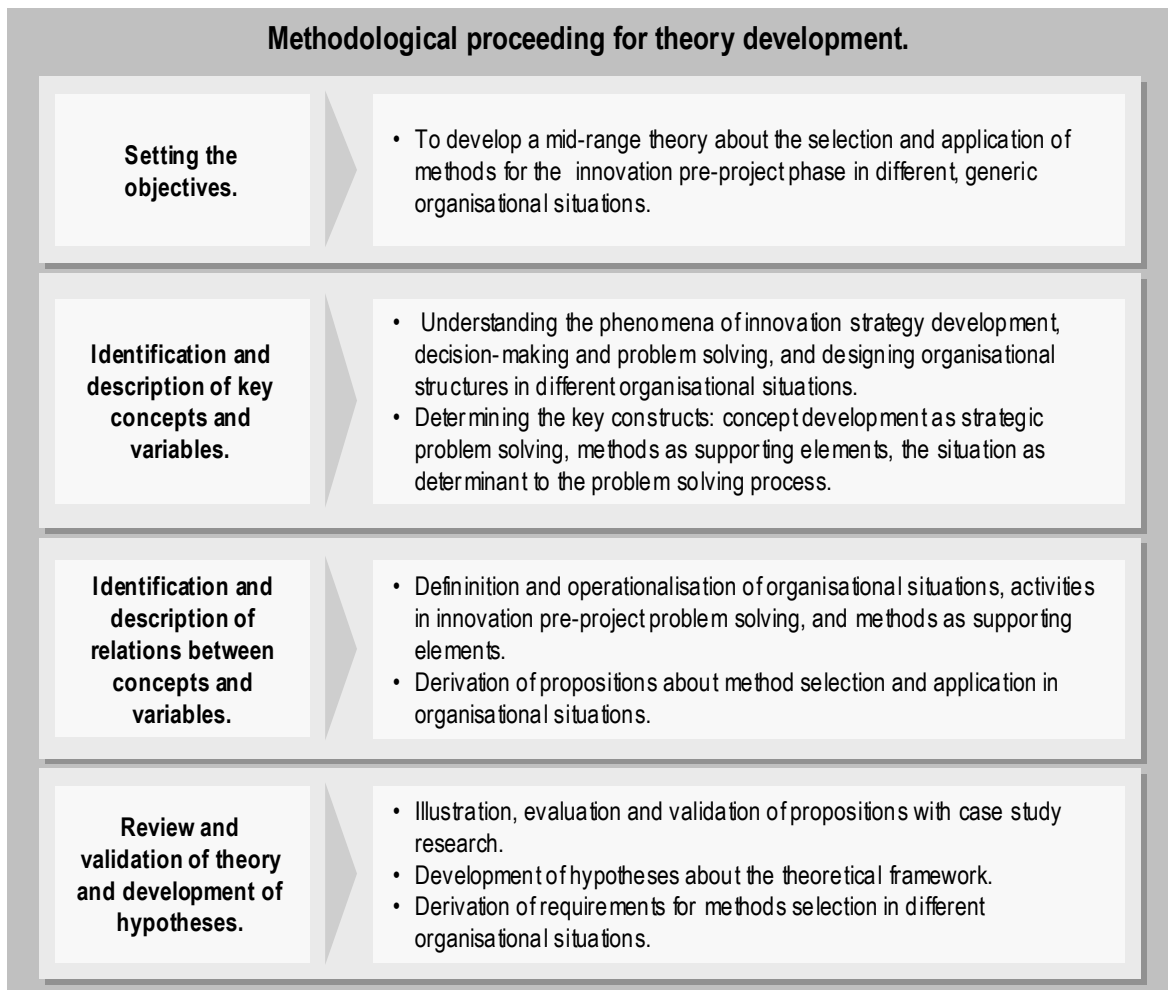


Figure 12: Methodological Proceeding, compiled by the author.

### **3.4 Summary.**

In this chapter, the concept of theory was introduced as providing explanatory structured knowledge about a broad range of research objects on an abstract level. Further, the way of developing new knowledge, the theorizing process was introduced more closely and the quality criteria for good theory were described. This research was introduced as a project between the two concepts of basic research and applied research, because the conceptual perspective is entirely new to the field of pre-project innovation processes and thus allows researchers to conduct further investigation for applicable results. Consequently, the research logic is more deductive in the first part in order to develop a theoretical framework on the basis of existing research. In the second part, on the basis of the theoretical framework, an inductive approach based on qualitative, case-based methods will help to validate the developed propositions and therefore, concrete hypotheses can be developed. As a result, this research is theory building rather than theory testing. In order to meet the new challenges of this new research field, a specific proceeding for the development of theory was developed.

The research topic is tangential to the vast fields of organisation and strategy research that overlap to a high degree. The starting point for this realist research is existing theory, which will be evaluated empirically in a subsequent step. A detailed research methodology will be developed and described for each step in the appropriate chapter.

In the next chapter, the topic is going to be described from organisational and strategic perspectives, in order to identify the key constructs and variables that influence the research objects. A theoretical framework will be developed along the research topic of innovation pre-project activities and the most important perspectives of organisation, strategy, and the content for pre-project processes.

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In this chapter, a strategy was developed of how to reach this objective.

## **4 Establishing the Theoretical Link Between Strategy, Organisation, and Innovation Problem Solving.**

*Chapter aims: In this chapter I will develop the background for the theoretical framework, in order to identify the key concepts and variables. My main objective is to describe the innovation pre-project phase as a strategic problem solving and decision making process which is determined by organisational and external contingencies. Further, I am going to describe the concept of methods as a means to support the problem solving process by structuring the collection, processing and communication of information.*

The overall research objective of this thesis is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In order to reach this overall objective, objective 1 of this research is to develop a theoretical framework for the conceptual analysis and description of the fuzzy front-end of innovation processes. In this chapter, the necessary basis for the development of a framework will be developed.

In order to develop a theory about the selection of methods for the pre-project innovation phase in different organisational situations, the key concepts for explanation have to be defined to allow the definition of relevant variables at a later stage. The key concepts originate from three research fields. In chapter two, it was shown that innovation concept generation and strategy development are conducted synchronously to a high degree. Thus, in the first step the relations of strategy, organisation and innovation are going to be explored. Further, it has been shown that innovation concept generation is a creative process. This process can best be described as a decision making or problem solving process. Hence, this is the second research field that is going to be explored. Moreover, in innovation processes, organisational capabilities and environmental demands are matched in order to define an innovation concept that can be economically exploited. The external environment defines the concept of an organisational situation, which can be explained by the contingency view.

## **4.1 Innovation and Strategy Development.**

In this section, the relation of innovation, strategy and organisation are going to be described in brief, in order to define the term of innovation strategy and to allow a positioning of this research project in relation to strategy research. As the research topics of organisation and strategy are closely tied to one another, it is necessary to provide an overview about these research fields. Thus, different research streams on strategy are going to be described in order to introduce and select appropriate approaches as a theoretical background for the further research.

### **Widespread research on the phenomenon of strategy needs classification.**

The field of strategic management deals with the question of how to achieve and sustain competitive advantage (Rumelt et al, 1994). Hence, a strategy defines the way of creating economic benefit. Mintzberg et al. (1998) distinguish five different meanings of the term strategy: strategy can be a plan, a pattern of behaviour, a ploy or a position. Further, they add the concept of a pursued strategy meaning the actual result of strategic activities and thus strategy from an ex post perspective that can also differ from planned behaviour. Strategy is a complex construct and thus, different perspectives lead to different definitions. As a result, this typology shows redundancies: a ploy can be a plan, a position can be the result of a behaviour or a result of a pursued strategy, while a pursued strategy can be the result of planning or a behaviour. To summarise, the term of strategy contains a high potential of vagueness based on the fact that numerous different schools of thought about the topic exist. Due to the high number of approaches, an exact determination of the term strategy and in consequence of schools of thought is only possible by allowing reasonable overlap and redundancy, and pointing out rather tendencies of affiliation to schools of thought rather than exact categorisation (Chaffee, 1985). In the further proceeding, four ways of categorising approaches to strategy research will be introduced: Mintzberg et al (1998) explain the relation between strategy and organisation, Chaffee (1985) distinguishes on the level of processes of strategy development, Teece et al (1997) classify schools of thought by the source of competitive advantage, and Bailey (1999) defines strategy as a result or as a process.

### **Mintzberg et al (1998) have identified ten schools of thought.**

Mintzberg et al (1998) describe ten schools that can be categorised in three major types: prescriptive schools, descriptive schools and one configuration school. Schools of the prescriptive category have a normative character: they work out how a strategy should be developed and they describe consequences for an organisation. The descriptive schools describe how strategies are developed or pursued. In the configurational school, Mintzberg's (1989) theory of organisational configuration and resulting strategies is described.

Prescriptive schools like the design school (e.g. Chandler, 1962), the planning approach (e.g. Ansoff, 1965) and the positioning school (e.g. Porter, 1980) assume that strategy is the result of an analysis and planning process. This implies understanding situational and environmental factors and developing and implementing a strategy that creates competitive advantage and economic benefit. A pendant to the design school on organisational level is the contingency view (e.g. Pugh et al, 1969), in which organisational design is assumed to be a consequence of situational aspects which is deliberately designed for strategic purposes.

In descriptive schools of thought, the actual process of strategy development and implementation (one of the five strategy types explained above) is described. Examples are the entrepreneurial



### Establishing the Theoretical Link Between Strategy, Organisation, and Innovation Problem Solving.

school, where strategy is seen as an entrepreneurial act (Schumpeter, 1942; Drucker, 1970), or the decision school (March/Simon, 1958), where strategy development is explained as an organisational decision process. The third category lies in between the two. The configuration school analyses the development of strategy in different types of organisational configurations and concludes that strategy development is an interplay between organisational constraints and strategic requirements (Mintzberg, 1989).

#### **Chaffee (1985) distinguishes three models of strategy.**

Chaffee (1985) stresses the circumstance that strategy research lacks consistency. According to Hambrick (1983), this is due to the fact that strategy is multidimensional in nature and specific to an organisational situation. The basic premise, that environment and organisation are inseparable (e.g. Lenz, 1980), leads to the problem that an organisation always has to deal with changing environments and thus new strategies of how to deal with the environment have to be developed. This makes the strategy development process an unstructured, non-routine and non-repetitive process with considerable effect to the organisation (Hambrick, 1980). Chaffee (1985) found three definition types of strategy, intended, emergent and realised strategies. Further, she describes corporate strategy that deals with the question of which businesses to act in and business strategy that deals with the questions of how to act in each business. In each case, strategic management includes the content of strategy and the process of development and implementation. Focusing on the process of strategy development, she distinguishes three types of strategy: a linear model, an adaptive model and an interpretive model.

The linear model is analogue to Mintzberg et al's (1998) prescriptive schools. According to the linear view (which focuses on planning), strategy consists of decisions, actions and plans that set organisational objectives. Thus, goals and means are results of strategic decisions. The linear model assumes that strategies are planned, formulated and implemented.

A further development of the linear model is the adaptive model. Chaffee (1985) bases this model on Hofer's (1973, p 3) definition that characterises strategy as "*concerned with the development of a viable match between the opportunities and risks present in the external environment and the organization's capabilities and resources for exploiting these opportunities.*" Thus, strategy development is a continuous process of the assessment of internal and external factors. This model is different to the linear model in several ways. Here, the process is ongoing and not a one-off event, and the process is not only focused on major, but also on minor, decisions that in sum make the resulting strategy. Thus, strategy development is seen as less centralised.

The third model according to Chaffee is the interpretive model. Here, in contrast to the adaptive model, where the organisation is seen near to an organismic or biological view, this model is based on social contract (Keeley, 1980). This social contract view implies that organisations are able to attract individuals to join the organisation for collaboration. One assumption is that reality is not objectively existing, but is socially constructed and thus reality cannot be perceived as right or wrong. As a result, strategy in the interpretive model is defined as orienting frames of reference for common understanding between the organisation's members and its stakeholders. The interpretive model can be seen as a descriptive school type in the sense of Mintzberg et al (1998).

#### **Teece et al (1997) use sources of strategic benefit as a factor for classification.**

Another approach to categorise schools of thoughts is by distinguishing sources of strategic advantage, as Teece et al (1997) do. They distinguish four paradigms: competitive position, strategic conflict, resources, and dynamic capabilities. The competitive position paradigm was introduced by Porter (1980, 1985) who defined competitive advantage as resulting from differentiation, cost

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leadership or focus in positioning against the five forces of direct competitors, substitute producers, suppliers and customers. The strategic conflict or economic approach (e.g. Shapiro, 1989) applies the tools of game theory and thus implies that strategic benefit and beneficial market positions result from strategic measures like pricing strategy, signalling and control of information. The resource perspective or resource-based view (e.g. Penrose, 1959; Rumelt, 1984; Teece, 1984) emphasises an organisation's capabilities and resources as sources for competitive advantage, as these allow effective and efficient processes to be designed. Dynamic capabilities are a further development of the resource-based view by Teece et al (1997). They stress the inimitability of capabilities that define the uniqueness of an organisation as the central source for competitive advantage. The resources defining capabilities are organisational routines, core competences, and products as categories for further subcategories of further, more detailed factors (see Teece et al, 1997 for a full discussion).

### **Schools of thought can be described from a process or a result perspective.**

In order to categorise approaches to strategy on a more abstract level, Bailey (1999) outlines the difference of strategy seen from a content point of view or from a process point of view. His research was intended to investigate different types of strategy development processes. This approach required a distinction allowing him to clearly differentiate strategy content from strategy processes. In this research, the relation of content and process should be retained, but a clear distinction is necessary in order to choose the relevant approaches for the development of a frame of reference. Taking into account that prescriptive schools of thought have ideal-type strategy processes as an issue, in this research, the term content relation would be misleading and so the term result focus will be used. Combining these views, the following two major categories can be derived:

- Strategy from a result focused perspective means approaches that define a strategy as a given, static set of objectives, resulting from a certain process. These approaches are of a normative character and focus on the content of strategy and on the ideal type of a generic strategy process. In these schools, organisations play a background role, because they are seen as instruments or targets in which strategies are implemented.
- Strategy from a process focused perspective means approaches describing the process of coming to a strategy. These approaches are of a descriptive character and focus on the interaction between strategy deploying instances and show a close relationship of strategy and organisation, the environment where strategy development takes place.

The following tables provide an overview about the schools of thought in strategy and organisation research, as described in the sections above. The table does not consider sources of strategic advantage but focuses on organisation or strategy, process or result. Thus, it does not contain Teece et al's (1997) categories.

## Establishing the Theoretical Link Between Strategy, Organisation, and Innovation Problem Solving.

Result orientated, static normative					
	School of thought	Authors	Central issue	Strategy is seen as	Organisation is seen as
Strategy Focus	Economic	Nellis/Parker (2002), Shapiro (1998)	Economic behaviour and interdependencies	The result of an economic process of analysis, considering market needs, competition, cost structures and elasticities, and game theory. Strategy is made to reach economic goals.	Organisation is necessary to produce and deliver products. It is a cost factor and needs to be designed for efficiency. Organisation plays a passive background role.
	Design	Selznick (1957) Chandler (1962)	Strategy as a conceptual process	A concept created after analysing strengths and weaknesses of an organisation and threats and opportunities of the environment	" <i>structure follows strategy</i> "; the strategy is implemented into an organisation
	Planning	Ansoff (1965) Steiner (1969) Kaplan/Norton (1998)	Strategy development as a formal planning process	A set of objectives and sub-objectives, hierarchies of strategies, control mechanisms.	The strategy is implemented and controlled in the organisation.
	Positioning	Porter (1980) Schendel/Hofer (1979)	The content of strategies, focus on four types of key strategies	Economic plan of action	A value chain to be analysed for differentiation or cost reduction potentials
Organisation Focus	Contingency View	Pugh et al (1969, 1969a)	Organisational Design as a consequence of situational aspects	Developed for a special context, there is no one best strategy	Organisation can be deliberately designed and is shaped by situational aspects
	Taylorism/ Bureaucracy	Weber (1947) Smith (1772) Babbage (1832) Taylor (1911)	The exact planning of processes in Organisations	A plan that has to be realised by the organisation	A means or even a machine-like institution to realise planned action

**Table 1: Result orientated, static, normative schools of strategy, based on Mintzberg et al (1998), further developed by the author.**

Process orientated, dynamic, descriptive					
	School of thought	Author	Central issue	Strategy is seen as	Organisation is seen as
Strategy Focus	Entrepreneurial	Schumpeter (1942) Drucker (1970) Pinchot (1985)	Strategy as a visionary process, entrepreneurs, personalities and roles	The vision of a leader; rather an image than a plan	Following the leader's vision; shows resistance;
	Decision/Cognitive School	March/Simon (1958) Reger/Huff (1993) Bogner/Thomas (1993)	The process of information seeking and processing, cognition of managers	The outcome of a mental process	A system consisting of information gathering, processing and communicating people
	Learning, Self Organisation and Knowledge Management	Lindblom (1959) Wrapp (1967) Quinn (1980) Senge (1990)	The description of the actual strategy development process	The outcome of an emergent process	The place of learning, knowledge and strategy generation.
	Power	MacMillan (1978) Sarrazin (1975) Pettigrew (1977)	The process of negotiation. Coalitions and interest groups	The result of a political process.	Environment and source of power for negotiation, coalition of interest groups.
Organisation Focus	Cultural/ Interpretative	Pettigrew (1985) Johnson (1992) Edwards (1977) Chaffee (1985) Schein (1992)	Shared beliefs and understandings of members of an organisation	The outcome of a collective process	A framework of rules for culture
	Evolutionary	Hannan/Freeman (1977) Van de Ven (1979)	The environment as central actor	A reactive process to changes in the environment	Responding system in danger of being selected out
	Configuration School	Mintzberg (1989) Hurst (1995)	The configuration of organisations leading to strategies	Outcome of interaction of planning and evolving results.	Changing and adapting environment that allows strategy to evolve.

**Table 2: Process orientated, dynamic, descriptive schools of strategy, based on Mintzberg et al (1998), further developed by the author.**

### **A definition of strategy and innovation strategy.**

Innovation management and strategy development are closely related to one another. Business strategy defines the frame for innovation strategy and innovation activities influence strategy development by developing concrete alternatives or concepts for realisation. Further, strategy and

### Establishing the Theoretical Link Between Strategy, Organisation, and Innovation Problem Solving.

organisation are two research topics that cannot be researched independently in an holistic way. To summarise, the following conclusions can be made:

Strategy development and thus innovation concept development is a process in which environmental challenges are matched with organisational capabilities and resources in order to gain economic benefit. Hence, organisations conduct a problem solving process in which the environmental factors and organisational resources are analysed and requirements for future development are defined. As a result it is possible to develop product and service concepts that are both promising to be economically successful and realistic to be pursued.

For the further proceeding, strategy will be defined as the frame for development and selection of means that generate competitive and economic advantage for an organisation in a defined environment. Thus, an innovation strategy defines, and sets the frame for the creation of means that generate strategic benefit for an organisation. These means have to be novel and open for economic exploitation.

In the next two sections, the two schools of decision making and the contingency view are going to be introduced in order to set a theoretical background for the rest of the thesis. The decision-making and problem-solving schools enable a deeper analysis of the need for methods in the organisational context of strategy and innovation concept development. The contingency view is appropriate, because it defines sets of environmental contingencies that define organisational requirements.

## **4.2 Decision-making, Problem-solving, and Information Processing in Innovation Pre-project Processes.**

*"Decision making is, simply put, the act of choosing among alternatives."* (O'Reilly, 1983: p105). O'Reilly's definition is short, but comes to the point of what the actual decision is. The act of choosing among alternatives is the core step in decision making. However, a decision making process is much more complex, because alternatives have to be developed, weighed according to preferences, and the consequences of the decisions have to be foreseen (Harrison, 1995). In this section, the decision making process, and its close relation to information processing and problem solving will be introduced and discussed. Different approaches to the three topics and core concepts in decision making will be introduced in order to understand decision making in the context of innovation management and to understand the importance of methods in the pre-project innovation phase.

Decision making is a multidimensional research problem. Environmental, personal and organisational factors play an important role (Harrison, 1995). Thus, the phenomenon has been researched from several research disciplines, like philosophy, psychology (especially personal, cognitive factors), sociology for interpersonal factors, and business research for the objective and the environmental factors that affect decision making (Mintzberg et al, 1998; Harrison, 1995). As a consequence, Harrison (1995) analyses decision processes on three levels: the process, the decision maker and the decision itself. This structure will be used in order to introduce the topic of decision making. First, Harrison's (1995) model of a decision making process will be introduced. Then, the terms of decision making, problem solving, and information processing will be compared. Different schools of decision making will be introduced in order to select the most important factors that affect decision making at an organisational level. In the last step, the decision itself will be set into the context of pre-project innovation management.

### **A decision making process model.**

According to Popper (1972), an influential German-British philosopher, the whole of life is about decision making. Thus, decision making is an integral part of organisational management (Harrison, 1995; Mintzberg et al, 1998). According to Mintzberg et al's (1998) typology, decision making is the core concept of the cognitive school of strategy development. This implies that information collection, processing, learning and communication are the main activities in the decision making process that lead to an organisational strategy.

Harrison (1995) develops a six-step model to describe a decision process in the context of managerial decision making. First, managerial objectives have to be set, then alternatives are searched in order to compare and evaluate them. This activity includes scanning the internal and external environment for information, and relevant information is bundled in order to formulate alternatives. These alternatives project actions onto the managerial objectives, and thus represent the courses of action which will be implemented. The act of choice follows as soon as the best alternative is defined, and according to the objectives, the most promising alternative is selected. After the act of choice, decisions are implemented and followed up. The model is not purely linear. It contains links from alternatives development to objective setting, because in the process of alternative formulation, objectives can be further developed and changed, and thus have to be revised. Further, while implementing the decisions, new alternatives can emerge and a new search has to start. The process then starts from new, as soon as decisions are implemented and revision of results has been completed, new decision processes start. The following figure illustrates the process.

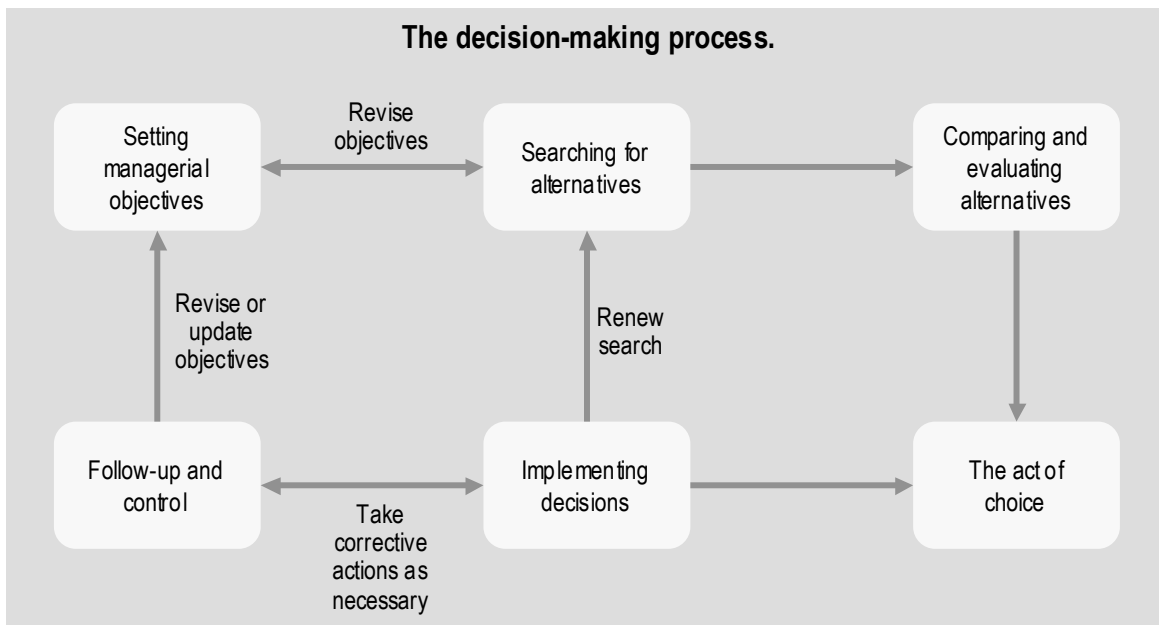


Figure 13: The decision-making process (Harrison, 1995).

This model implies several assumptions. First of all, the model assumes that objectives exist and that they are more or less explicit, which means that the decision maker or makers have consistent and clear ideas of their objectives and priorities. Further, information has to be available, for processing and alternatives have to be the result. The question is whether alternatives really exist after information collection or whether there is nothing that can be done to reach the defined objectives. If the objectives do not exist completely and consistently at the beginning of the process, the model suggests that over the course of alternatives development, these objectives are defined and refined. It is possible that in the course of implementation further alternatives evolve or the respective alternative turns out to be unrealistic. As a result, the process of objective definition can never be complete. In this case, the decision turns out to be more of a problem to solve. Thus, in the next section, the relation between decision making, problem solving and information processing is going to be introduced.

### **Decision making and problem solving require information processing.**

Harrison's model suggests that decision making is not only about choice but also about implementing decisions. Here, the close relation of decision making and problem solving becomes clear. The terms are often used interchangeably, because they are so closely related and many different concepts exist (Smith, 1988). However, the terms are not synonymous, as the terminology of some researchers may suggest (e.g. MacCrimmon/Taylor, 1976, or Huber, 1986). According to Smith (1988), both concepts rely on thought or cognitive processes, and especially the generation of alternatives or their implementation can be problematic. Unlike decision making, problem solving does not necessarily imply choices to be made. When a problem has to be solved, then first the second order problem of how to solve the problem has to be solved (Smith, 1989). This second order problem also involves the development of alternatives and choice among the alternatives. Thus, problems can be caused by decisions and vice versa (Braverman, 1980). As a result, both decision making and problem solving are cognitive information processing processes that help decision makers and problem solvers to pursue their objectives.

**Lord and Maher (1990) classify research on decision making in four schools of thought.**

Harrison's model describes how a decision-making process can take place. In particular, defining and searching for alternatives is a cognitive information processing process. Different approaches have evolved to describe, analyse and influence decision making (Lord/Maher, 1990; Ungson et al, 1981). Lord and Maher distinguish four different models that lie behind decision-making and information processing research and suggest that research quality and resulting discussions could be improved by clearly knowing the presumptions and limitations of each of these approaches.

The first model is the rational model. The rational model assumes that all relevant information is being processed in order to optimise a desired outcome. The bases of the rational model are in economic theory and statistics, like pricing theory or investment theory (e.g. Friedman, 1976). Theory implies that decision makers have a utility function and know what the outcome of resource allocation to the different alternatives will be. Because different events occur, the consequences are weighed with their likelihood. The act of choice is controlled by rational decision rules which optimise the decision maker's benefit.

The second model is the limited capacity model, which is based on the research of March and Simon (1958), Simon (1955) and Cyert and March (1963). Due to the lack of descriptive value of the rational model, the limited capacity model focuses on how decision makers simplify information processing in decision processes.

The third model, the expert model, is based on the insight that in order to make decisions, people rely on existing knowledge structures that allow simplified information processing. This means that experts are assumed to have more detailed knowledge schema than non-experts and thus are able to make faster and better decisions due to their selective and systematic way of collecting and processing information.

The fourth, the cybernetic model tries to compensate the fact that the other models lack a dynamic view of decision making. Here, decision makers are able to learn and they receive feedback about the effects of their decision.

In their analysis, Lord and Maher (1990) compare these models along the dimensions of theoretical utility, their descriptive accuracy, the prescriptive value, and whether they generate applications that fit typical information processing. All the models have a strong theoretical utility, as they provide accurate and consistent models of decision making, each with their own purpose. The rational model has only weak descriptive accuracy, but a strong prescriptive value. Due to the lack of descriptive accuracy, applications generated out of the model normally do not fit typical information processing. The limited capacity model has the capability to compensate for the shortcomings of the rational model, with its strong descriptive accuracy, but weak prescriptive value. The descriptive accuracy allows well-fitting applications to be generated. The descriptive accuracy of the expert model is moderate, as it helps to distinguish between experts and non-experts, however a sharp distinction is not possible. This limited accuracy does not allow strong applications to be developed, although the prescriptive value is strong. The cybernetic model is very comprehensive. Thus, it shows high descriptive accuracy and strong prescriptive value. However, the comprehensiveness leads to the problem that specific applications are not very strong.

**Ungson et al (1981) distinguish two basic approaches to decision making.**

Another typology of schools in managerial information processing is provided by Ungson et al (1981), who distinguish rational, normative approaches and descriptive approaches. Their descriptive approaches comprise mathematical model-fitting approaches, process tracing approaches that observe the individual information collection, and theories of decision-making style. This typology is slightly different, but both typologies aim for a comprehensive typology and

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overview. They have in common that they both identify differences in prescriptive value and descriptive accuracy. It seems that especially the normative, rational approach and the descriptive, limited capacity model are exclusive, although both have their theoretical value. To conclude, the following important issues can be identified in the context of decision making, problem solving and information processing:

The objectives and interests of decision makers are the basis for decisions. In order to make decisions, define objectives, and collect and process information, the actors have to communicate. In order to define alternatives, information has to be collected and processed, which implies that the availability of information and the capacity to process information are an important issue. Finally, the combination of all these issues appears in organisations, which underlines the importance of organisational factors.

In the subsequent sections, these issues are going to be introduced in order to define a frame for the description of pre-project innovation processes from a decision perspective and for the description of the role of methods.

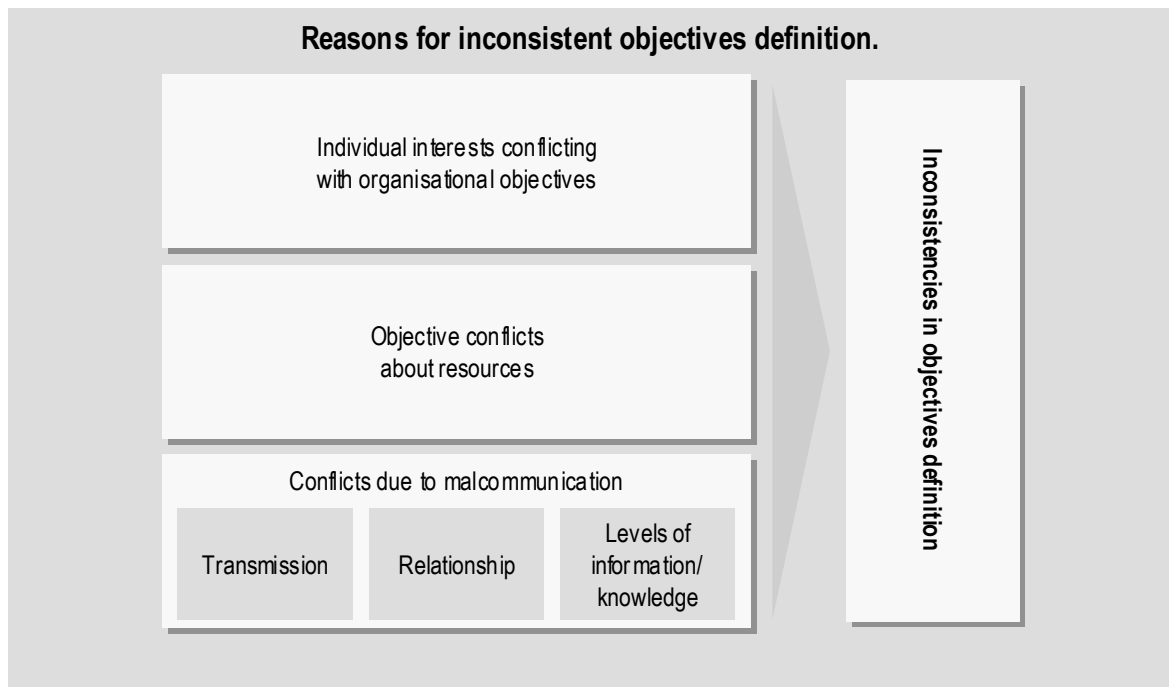
### **Factors of influence on decision making and problem solving processes.**

In his 1983 article, Charles O'Reilly develops a comprehensive set of hypotheses about the use of information in organisational decision making. These hypotheses are based on a theoretical framework that comprises three groups of variables. Contextual variables are related to the organisation. They describe the organisational structure (communication networks, roles, authority), incentive systems (rewards, punishments, goals, power), and group pressures (norms and conflict). The contextual variables influence information availability (quantity, quality, saliency, content, form, and credibility) and individual information processing (the perceptual set, used criteria, and processing style). Together, these three sets of variables have influence on the use of information in decision making processes. In the next steps, these issues will be explained in more detail.

### **Setting objectives in an organisational environment: communication and conflict.**

The definition of objectives for decisions in organisations can be confronted with two basic problems. Individuals often have problems to define consistent and clear objectives, as they have personal interests and interests defined by their organisational task (Harrison, 1995; Wigand et al, 1997). Further, by including more than one individual in a decision process, the inconsistency of one's objectives aggravates to the inconsistency of collective objectives. In the case the objectives of one decision maker are not aligned and depend on various factors, it is a challenge to define collective objectives that are consistent with all the individual objectives of the participating decision makers. This collective inconsistency, or conflicts can have objective reasons due to different interests of individuals, and reasons caused by communication. These communication-based reasons can be induced by the transmission of information itself (Shannon/Weaver, 1949; Daft/Lengel, 1984) or by the relationship among the actors (Watzlawick et al, 1967) who might not be willing or able to communicate, or by their different levels of knowledge for information processing (von Weizsäcker, 1972). The following figure illustrates the five problems.





**Figure 14: Reasons for inconsistent objectives definition, developed by the author.**

The rational model assumes that decision makers are purely rational, meaning that there is only one objective or a set of consistent, non-conflicting objectives that lead to a decision (Lord/Maher, 1990). However, decision makers are not purely rational and that means that objectives can be conflicting (Harrison, 1995). As an example, the objectively necessary outcome of a decision may conflict with a decision maker's objective to avoid loss of resources, status or power, or may be even supported by the decision maker's objective to increase resources or their personal income (O'Reilly, 1983). When more than one actor within an organisation has to share limited resources, naturally a conflict arises. This phenomenon can be called the objective conflict, and thus collective objectives inconsistency. Reasons for conflicts can also be caused by information and communication problems.

According to Watzlawick et al (1967), every communication has a content and a relationship aspect. Thus, pure content can be interpreted differently by different individuals with different relationships to each other. So, for example, conflicts among people with strong relationships can be solved more easily than conflicts among people who don't know or like each other. Further, Watzlawick et al (1967) distinguish between digital and analogue communication. Digital communication uses limited ways to communicate, like text or spoken language, and are suited best for content communication. Analogue communication, like intonation, gestures, or mimics communicates more than the pure content, and thus are suited to allow relationship oriented communication. This construct has been further developed by Daft and Lengel (1984, 1986), who develop the concept of media richness. In their model, they distinguish rich media, like face-to-face contact, or phone calls, and less rich media, like written documents, or numeric, formal documents. Depending on the complexity of the problem to be solved or decision to be made, the optimal richness of the medium has to be chosen in order to communicate effectively and appropriately. In their 1986 article, Daft and Lengel have further developed their model, and distinguish media by their capability to reduce uncertainty and equivocality. Less rich media can reduce uncertainty, because of their clear structure, and richer media can avoid equivocality or misunderstandings and thus allow agreements to be reached and the opposite's positions to be understood.

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The models above all imply that receivers of information are in the position to understand. In two cases, this is not possible. First, the communication can be disturbed by technical, geographical, or time related factors. Second, receiver and sender may have different knowledge or cultural backgrounds, so that they cannot understand each other. The first problem can be explained by the model of Shannon and Weaver (1949), who describe the process on a technical level by the components of an information source, a transmitter, a transmission channel, a receiver and the final destination who have to act synchronously in order to communicate. Any disturbance at any of these components can cause transmission errors. So, if one of these components is missing, or the interaction of these components is not functioning, the transmission is disturbed. The second problem can be explained by the confirmation/newness model by Ernst Ulrich von Weizsäcker (1972), a German sociologist. According to his simple model, optimal communication can only take place, if information is not too new but also not too familiar to both sender and receiver. Information can be too new for example if the information cannot be interpreted by the knowledge or cultural domain of sender and receiver. Further, information that has been confirmed too often leads to the problem that either sender or receiver do not provide the necessary attention for communication.

To summarise, in order to make good decisions and to solve problems effectively, a consistent set of objectives is necessary as Harrison's (1995) model suggests. However, individual objectives inconsistency and collective objectives inconsistency lead to the problem that clear requirements for alternatives cannot always be defined and thus, development, evaluation and implementation of alternatives is affected. Objectives inconsistency can be caused by objectively present conflicts or by communication induced conflicts.

#### **Availability of information: uncertainty and ambiguity.**

In the previous section, the issue of defining consistent objectives for the decision making and problem solving process was explained. In this section, a second important problem is going to be introduced: even if consistent objectives exist, it is not necessarily the case that all relevant information is available to the decision makers. Of course, the models of communication also apply for information acquisition. Due to different interests, actors can avoid giving important information to other decision makers, or the acquisition is disturbed by one of the many factors. In addition to communication problems, uncertainty and ambiguity play an important role (Milliken, 1987; Schrader et al, 1993). In his extensive review about environmental uncertainty, Milliken (1987) identifies three types of uncertainty: state, effect, and response uncertainty. Defining uncertainty as "*an individual's perceived inability to predict something accurately*", Milliken (1987: p136) states that uncertainty comprises uncertainty about the current state of the environment, and its development in the future. Effect uncertainty implies uncertainty about the effects of environmental changes to the organisation, and response uncertainty is uncertainty about the effects of decisions and their value to the decision maker. As a result, due to state, effect and response uncertainty, information is not always available in order to define appropriate alternatives, and the question as to whether objectives can be met by a decision, becomes unclear and thus, decision risk evolves (Harrison, 1995).

Environmental uncertainty is not the only factor that affects information collection and alternatives definition. Schrader et al (1993) have developed a framework that adds the concept of ambiguity to the problem of uncertainty. In contrast to uncertainty, which can also be described by a lack of information, ambiguity is defined by a lack of clarity regarding the relevance of variables and their functional relation (Schrader et al, 1993; Martin/Meyerson, 1988). Schrader et al suggest that ambiguity results from the absence of adequate mental models about the functional relationships of variables. Decision makers develop these relationships by the use of information, and apply them to simulate the outcome of an action or decision (Mintzberg, 1976). Thus, mental models allow decision makers to specify their information needs in decision making. In their model, Schrader et al (1993) define three major situations: uncertainty, where the decision maker knows about the problem

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structure, knows the variables, but not their values; ambiguity level one, where the problem solver knows the variables, but not their functional relationships, and ambiguity level two, in which decision makers know neither the relevant variables nor their functional relationships. Depending on the situation, whether ambiguity is high or low and/or uncertainty is high, too, the priority for the problem solver is either to build mental models first, or just to reduce uncertainty. As a result, it is not only important to define objectives for problem solving and decision making, but success is also dependent on available information about the environment and about the relationship between variables.

#### **Information processing: individual capability and style.**

In the last two sections, it was shown that the generation and choice of alternatives depends on the objectives that have been set and on the availability of information. However, the availability of information alone is not enough. It is also important as to whether information is also acknowledged to be useful for a decision. The concept of limited rationality was already introduced, but not illustrated yet. The rational model assumes that objectives are set and information is being collected in order to develop and choose the most appropriate alternatives. The collection and processing of information relies strongly on two factors: first, the information to be collected has to be defined as relevant and further it has to be processed appropriately in order to evaluate the quality of the generated alternatives. This problem has been researched mostly in the descriptive schools of decision theory, based on March and Simon (1958), Simon (1955) and Cyert and March (1963), and also Mintzberg (1976). This concept describing the shortcomings of rational approaches is called limited rationality, or in the context of March and Simon, bounded rationality (Harrison, 1995). The concept of bounded rationality describes decision-making behaviour around the phenomenon of satisficing, which implies that decision makers seek for satisfactory rather than for optimal decisions (Harrison, 1995; Wigand et al, 1997; March/Simon, 1958). Satisficing behaviour implies that objectives, values, assumptions or constraints influence the rationality of a decision maker (Harrison, 1995). Harrison summarises these cognitive limitations as follows:<sup>15</sup> First, human decision makers can only process a limited amount of available information, their knowledge, intelligence and memory are limiting factors. Decision makers with strong beliefs and values may tend to negate the existence of information other than those supporting their values. The willingness to take risks may be different between individuals, and the personal aspirations may differ so that objectives with higher priorities but not rationally part of the decision are satisfied earlier. To summarise, bounded rationality can be a constraint to decision making quality, because individual information needs and processing behaviour differ from rational information needs.

#### **Decision making and methods in pre-project innovation processes: a working definition.**

In this final section, the role of methods in the pre-project innovation phase will be discussed. As seen in chapter two, in the earliest phases of the innovation process, strategy and innovation concept generation are very closely related. As strategy acts as a frame, and the innovation concept represents the activities that pursue the strategy, both have to define each other. As a result, a pre-project innovation process is a decision and problem solving process. A first-order problem represents actual objective of the problem solver. A second-order problem defines the way of solving the first-order problem, and it needs to be addressed before the first-order problem can be solved. The question of what to do in order to attain benefits is the strategic problem. The question of how to attain strategic or economic benefit is the innovation problem. The first-order innovation problem is the actual concept definition (see Smith, 1989). This second-order problem has to be solved on an

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<sup>15</sup> these limitations can also be found in O'Reilly (1983)

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organisational level (how to interact within the organisation, see for example Galbraith, 1982), and on a conceptual level (what is the concept and how does it please customers' needs). On the conceptual level, two problems have to be solved: customer needs have to be pleased by the means of products and services, and on an organisational level, the new product or service needs to be implemented. The following figure illustrates the correlations of the presented problem and sub problem processes.

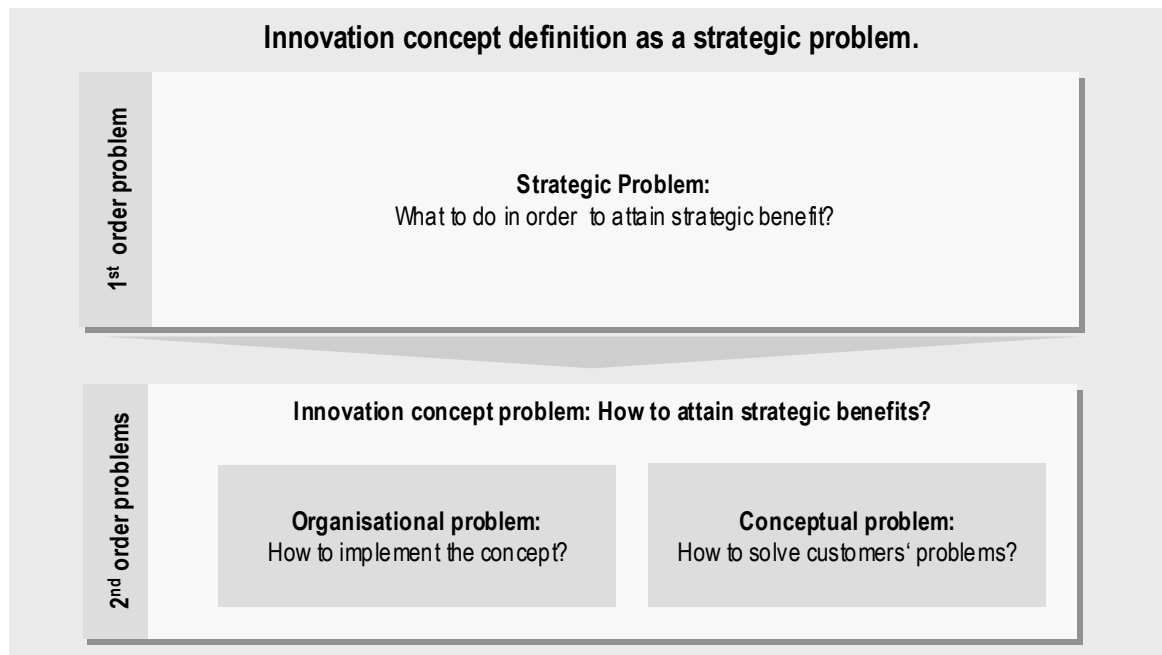


Figure 15: Innovation concept definition as a strategic problem-solving process, developed by the author.

As seen in the summary of chapter two, the concepts of strategy, concept generation, and organisation are highly interdependent. In consequence, the three problem solving and decision processes, on an organisational, conceptual and strategic level are closely related to each other as well. As a result, in the context of the defined issues above, this multidimensional problem solving process is a cognitive one in which relevant information has to be collected, processed, and communicated.

The pre-project phase ends with a decision about whether to run an innovation implementation project or not (see chapter two). Thus, it is a multidimensional decision process, in which objectives have to be defined, alternatives have to be developed and evaluated, a choice has to be made and the question of how to implement the alternative has to be answered. Here, the role of methods that facilitate the process become relevant:

As a means or utility to facilitate the decision process, methods support information collection, processing and communication among the decision process participants.

In consequence, methods can help to define information needs, provide information sources, contribute with models to process information, and offer media for communication, in order to compensate external uncertainty and ambiguity, overcome shortcomings in information processing capacity of participants, and to facilitate the definition of their objectives. O'Reilly's (1983)

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hypotheses about the use of information in organisational decision making will be summarised in order to illustrate how methods can support the decision process.

**General information behaviour of individuals:** O'Reilly assumes that only limited amounts of information will be used and that the same information will be processed differently by different decision makers. Over time, decision makers will be more likely to interpret favourable information as less ambiguous than at the beginning and they will be more likely to forget unfavourable information. In this context, methods can help to provide a structure for information collection and storage in order to provide a certain, objectively higher standard of information.

**Trust and verification factors:** in his further hypotheses, O'Reilly assumes that information is more likely to be used when it comes from trustworthy sources, or sources which have an interest in a decision. Further, directly received information is more likely to be used than information transmitted via several links. Here, methods can help to transmit information in rich channels, in order to avoid misunderstandings and thus, mistrust.

**Information format factors:** O'Reilly assumes that information is more likely to be used by decision makers, when it is readily accessible, summarised and presented orally. Methods can help to structure information, standardise its collection and help to transmit it by richer media.

**Organisation related factors:** In general, O'Reilly assumes that individuals will more probably use information, when it supports their personal objectives, and the organisation's sanctioning and incentive mechanisms support the use of certain information. Further, the use of information should not lead to conflicts among organisational members. Although not directly relevant to problem solving methods, these factors are shown here, because they will have to be filtered at a later stage of this thesis.

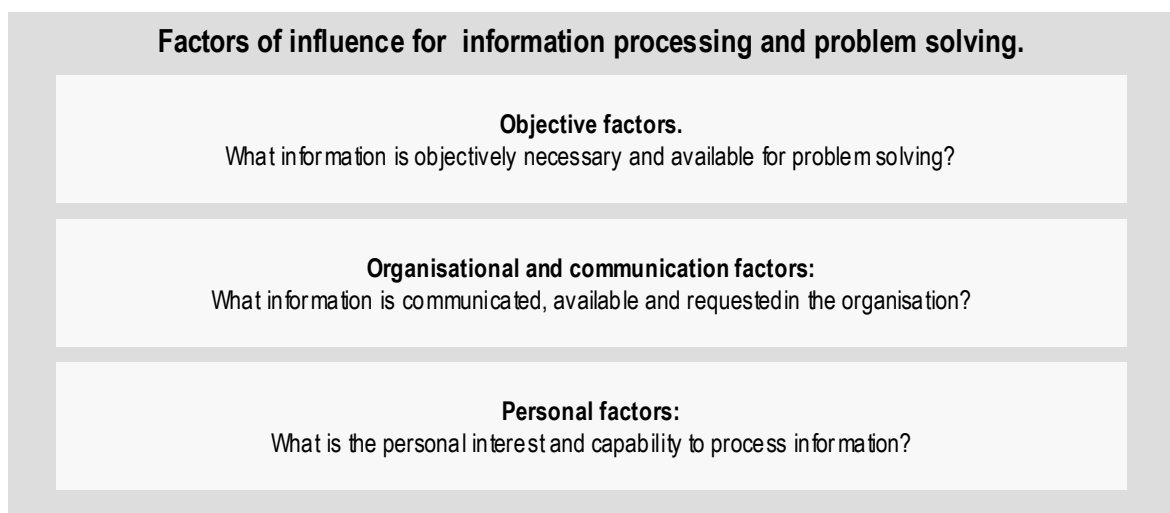


Figure 16: Factors of influence on information processing and methods selection, developed by the author.

**The further focus lies on objective information needs and method selection.**

It has been shown above that decision processes are influenced by several types of factors: on an objective level, the problem or the decision itself defines the information need and the methods that

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are necessary to solve the problem. On a personal level, the decision makers need to have resources, skills and capabilities to apply the methods. Further, on an organisational level, the interaction and communication among the actors influences objective-setting, information processing and thus, method selection.

In order to further focus on information needs and methods in strategic organisational situations, personal factors and factors of interaction are not going to be further explored. Instead, the focus will lie on the objective information need and method selection for pre-project innovation decisions according to different organisational situations. In this section, so far the role of decision making, problem solving and methods for pre-project innovation processes have been explained. In the next section, the role of organisational structure and its relation to the external environment will be introduced in order to define the concept of an organisational situation.

### **4.3 The Contingency View as Basic Framework.**

In this section, the contingency view will be introduced as a valuable approach to understand and describe organisations and how they are influenced by their environment. In the first step, the original approaches to contingency theory will be introduced, to be followed by a critical review of the approaches. Then, the contingency perspective will be introduced in the context of innovation management. A critical review of the approaches leads to a definition of objectives for further research and for this research project.

#### **The contingency approach is not a theory.**

The contingency view has its roots in systems theory and organisational decision making (Mullins, 1999). From organisational decision making around March and Simon (1958) evolved the question of which organisational measures are best suited for organisational effectiveness and decision making. The most important assumption behind contingency theory is that organisations are open systems that interact with their environment with the result that internal needs and external requirements have to be balanced (Morgan, 1997). The second assumption is that there is no one best way of organising. The appropriate organisational form depends on the task or environment and thus the organisational objectives that define organisational effectiveness (Morgan, 1997; Mullins, 1999). As a result, different forms of organisation appear in different environments and different management styles are to be found in different organisational frames, because it is the management's main task to seek alignment and fit of requirements and organisational structure (Morgan, 1997). The contingency view in its original form provides measures to analyse the environment and to design organisational structure. It has become one of the most influential approaches in organisational analysis from the second half of the 20th century until today.

One of the first important studies that calls for the contingency view was conducted by Burns and Stalker in the late 1950s. They analysed organisational behaviour in the context of innovation by comparing organisations from different industrial sectors with different products and processes (Burns/Stalker, 1961). They illustrated that constantly changing environments require open and flexible organisation types in contrast to stable environments. Successful organisations in changing environments showed what they called "*organic*" organisations, while efficient and successful organisations in stable environments had "*mechanistic*" organisational structures. Their organisation types were described along the dimensions of nature of environment (stable vs. unstable), nature of task facing the firm (efficient production vs. exploitation of rapid changes), organisation of work (clearly defined jobs vs. attempt to deliberately avoid job specifications), nature of authority (formal hierarchy vs. informal and constantly changing authority), communications system (regulated and vertical vs. completely free and informal) and nature of employee commitment (associated with job descriptions vs. commitment to tasks).

A further important step towards contingency theory was Woodward's (1965) study about the relationship between applied technology and organisational structure. Although different technologies require different structures and implications for individuals, Woodward's findings suggested that structure and technology are dependent on strategic choice, and that a balance has to be found that allows effective organisation.

In 1967, Lawrence and Lorsch refined the findings of Burns and Stalker, by adding the perspective of organisational subunits. Their findings suggested that in addition to the need for different organisations in different market and technology environments, more uncertain and turbulent environments need a higher degree of differentiation than organisations in stable environments

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(Morgan, 1997; Mullins, 1999). In consequence, production units had more formal and bureaucratic structures, while research and development units adopted more informal structures.

Over time, in contingency theory a large number of variables or situational factors, that influence organisational performance have been developed in order to analyse and describe organisational effectiveness depending on organisational structure, its subsystems and the external environment (Mullins, 1999). For example, Perrow (1970) has analysed the effects of applied production technology, and Porter et al (1975) have analysed the effects of organisational size on its structure.

As a result, contingency models can be seen as theory based on if-then relationships: If certain situational factors exist, then certain organisational and managerial variables are most appropriate. Contingency approaches are seen as mid-range theories (Zeithaml et al, 1988). The broad acceptance and adoption of contingency theory has led to a variety of different contingencies but one general, widely accepted set of organisational variables and contingency factors have not been developed. In order to allow more consistent recommendations for organisational design, the description of organisational structure has been based on one relatively general contingency, the organisational task.

### **Describing the organisational task as contingency assures general applicability.**

In the further development of the contingency approach, influential researchers such as Mintzberg (1983, 1994), or Galbraith (1994) have developed more prescriptive frameworks, that explain how to match organisational structural templates to specific task environments. In a very comprehensive approach, Picot (1993) derives from Ouchi (1979), Perrow (1970) and Hill et al (1989) a framework for the categorisation of tasks which influence the variables for organisational structure. In the first step, tasks are distinguished by their structuredness, which is derived by knowledge of inputs and definition of outputs. In a second step, variability of tasks is set in relation to structuredness of tasks. As a result, there are four basic types of tasks: highly structured and stable tasks, like efficient production processes; low structured, but stable tasks, like craftwork or education; highly structured and highly variable tasks like building construction or computer programming; and unstructured, highly variable tasks, like research and development or strategic planning.

When the tasks are sufficiently analysed and described, and the environment and organisational capabilities are evaluated, the variables of organisation can be designed in order to define the organisational structure. To date, there is no general, exhaustive and consistent framework for the description of organisations. They vary across the research backgrounds of authors, and thus the variables according to Picot (1993) will be introduced as an example for a comprehensive collection.

- The variable of “division of labour” defines how the tasks are divided into subtasks and how they are assigned to different instances within the organisation. Instances can be staff, departments or project groups which have the right for task execution.
- The variable of “direction rights” defines the hierarchical structure of the organisation, like a line system or matrix organisation.
- The division of “decision rights” defines who has to be involved in decision making processes in the context of a task. Decision rights can be centralised, decentralised, participative or delegated.
- The “programming” variable defines the degree of documentation, control, definition of outputs and the frame of action for organisational processes. As a result, highly programmed processes are well-defined and inputs and outputs are exactly known. Less programmed processes are value oriented, where inputs and outputs cannot be defined, but standards for result evaluation can be specified.



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- The “communication processes” variable defines the flow of information within the organisation. For designing communication processes, decisions about formal and informal communication paths, communication roles, and communication media have to be defined.
- The “power” variable describes sources of power in organisations that enable the organisation designers to generate a balanced organisational structure. Based on French/Raven (1959) and Irlle (1971), Picot (1993) distinguishes five sources of power: legitimation, sanctions, identification and charisma, information and control of environment.

On the basis of these variables of organisational structure, an organisation can be designed according to the tasks conducted which are defined by strategy and environment. This step to make the organisational structure dependent on the task is very flexible and thus effective. However, designing the organisation structure is only half of the battle, because tasks vary significantly from one organisation to another, even if the same sub task is described. Strategy development and innovation concept generation is one of these unstructured, highly variable tasks for which it is possible to define an organisational structure, but not to define the task of the conception process itself. In order to develop requirements for methods, dimensions to describe the task have to be analysed and described in more detail. To summarise, the following table provides an overview about basic approaches to the contingency view.

Classic approaches in the contingency view.	
Effects of size	<ul style="list-style-type: none"> <li>• Porter et al, 1975 (behaviour)</li> <li>• Child, 1972 (economic performance)</li> </ul>
Effects of technology	<ul style="list-style-type: none"> <li>• Woodward, 1965 (structure and business success)</li> <li>• Perrow, 1970 (structure)</li> </ul>
Effects of environment	<ul style="list-style-type: none"> <li>• Burns/Stalker, 1961 (organisation type)</li> <li>• Lawrence/Lorsch, 1967, 1967a (structure)</li> <li>• Pugh et al, 1963/1964, 1969, 1969a (structure)</li> <li>• Mintzberg, 1979 (structure, organisation type)</li> <li>• Miller et al, 1988 (strategy development and organisation)</li> </ul>
Effects of task	<ul style="list-style-type: none"> <li>• Picot, 1993 (structure)</li> <li>• Perrow, 1970 (organisation type)</li> <li>• Hill et al, 1989 (structure)</li> <li>• Galbraith, 1973 (structure)</li> </ul>

Table 3: Classic approaches in the contingency view, table developed by the author.

### **The contingency approach has not been left uncriticised.**

Although the contingency view has been widely adopted, it has not been left un-criticised. Schoonhoven (1981) joined Mohr (1971) who was one of the first to identify problems with contingency theory. He found no support for the hypothesis that work groups are most effective when autocratic leadership is employed in routine jobs and democratic leadership in non-routine jobs. Further, Pennings' (1975) research analysed organisational effectiveness as a function of the goodness of fit or alignment between environmental and structural variables. Schoonhoven (1981) notes that both these studies have been criticised for methodological reasons, but nevertheless, these methodological shortcomings make the contingency view a controversial research field. First of all, the contingency view is not a theory, as it does not provide a consistent set of variables and constructs that are related to each other. It is more a research stream than a well-defined set of variables and propositions about interrelations of variables and constructs, in which researchers aim to find relationships between organisational and situational factors. For example, Schoonhoven criticises the assumptions of Woodward (1965) or Lawrence and Lorsch (1967), who assume that organisations are more successful, when they "*conform*" (Woodward, p 69-71) to their technologies or are "*consistent*" with external demands. These constructs are not clearly operationalised and thus theory cannot be tested. Further, the effects of contingency variables (the external factors) and the contingent factors (organisational effectiveness) are explained without having analysed the effects among the external factors. Thus, it is not clear which external factors influence organisational effectiveness. This leads to the problem that no function can be grounded and derived from verbal theory that could empirically explain contingency theory and hence be tested. In her study, she develops a function of contingency factors, organisational measures and their influence on organisational effectiveness, and tests Galbraith's (1973) organisational theory in 17 hospitals as sample organisations. Her results suggest that traditional versions of contingency theory do not capture the complexity of relationships between external factors and organisational variables. Although the traditional assumptions of contingency theory were not supported, the more precise hypotheses received stronger support. The contingency approach deals with organisations and assumes that they are open systems (Morgan, 1997). Because of human interaction and because individuals learn, the predictive value and thus the potential for quantitative evaluation of contingency research is reduced (Sayer, 1992; Tsang/Kwan, 1999, see also chapter two). To summarise, applying the contingency view can be very effective. However, context variables and their context have to be made overt and analysed in more detail than in the original research works.

### **The contingency view has been applied in an innovation management context.**

In order to apply the contingency view more accurately, the individual context has to receive more consideration than before. In 2001, Tidd developed a framework for the application of the contingency view in innovation management. He states that innovation management is contingent to a broad range of factors and that a closer analysis of technological and market factors is necessary in order to identify the chances and limitations for innovation. Because there are no consistent and comprehensive frameworks of analysis in innovation management and due to other methodological limitations<sup>16</sup>, he sees the need for a framework that integrates the most important aspects in a comprehensive way in order to explain the impact of external factors to organisational innovation management. Although contingency theory is positivist and defines constraints rather than explains strategic choice, Tidd develops a multilevel framework, based on the fact that contingency theory offers the potential to understand how context affects management. In this framework, he

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<sup>16</sup> methodological issues in innovation management have been discussed in chapters two and three.

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implements his concept of strategic degrees of freedom (Tidd, 1993), which combines situational factors with strategic choice. As a result, the framework comprises environmental contingencies like uncertainty and complexity of the market and technology environment, the aimed degree of innovation (e.g. incremental or radical), organisational configuration (structure, processes), and organisational performance as a measure for success. These four areas are linked in a circle to show that they influence each other in a systemic way. He observes that only a small amount of research addresses the specific issue of innovation and this only focuses on the environment-strategy and strategy-structure linkages. By integrating a vast amount of research approaches, his framework enables future research to develop concrete measures to form innovation management strategy, processes and organisation that improve organisational performance according to environmental contingencies. He describes the dominant contingencies that influence organisational innovation. However, the strategy-method link to the conceptual level is not included in his framework. In the next section, an overview of contingency based research in the context of innovation management will be provided in order to further understand the value of this research stream.

#### **Recent approaches to innovation from a contingency perspective.**

To provide an overview of the contingency view applied in an innovation context, this must either be very broad or very narrow in scope. The contingency view is defined as an if-then relationship of a situational contingency to organisational variables (Mullins, 1999). As theory is defined quite similarly as the interrelation of variables and constructs (see chapter two), nearly every theory in the context of innovation management and strategy development at a company level could be an example for an applied contingency approach. Instead, the following table provides an overview about the newer approaches of the contingency view in the context of innovation management. Research conducted from a contingency perspective is not normally so explicitly classified. What the original approaches have in common is that they analyse a greater variety of constructs and variables in an organisational context and thus imply a certain complexity in their theoretical models. Further, they focus on organisational circumstances and derive recommendations instead of just listing possible alternatives without a specific problem context. Finally, the contingency view does not only focus on strategic aspects but also includes organisational processes or impact on organisational activities. Therefore, approaches that only focus on strategic alternatives<sup>17</sup> (Porter, 1980; 1985), or on different innovation types that end with strategic implications<sup>18</sup> (Abernathy/Clark, 1985; Christensen, 1997), or describe process types without referring to external contingencies<sup>19</sup> (v. Hippel, 1978) are not included in this list.

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<sup>17</sup>Porter (1980; 1985) provides a framework to analyse strategic positions and recommends generic strategies and measures like market entry barriers. He does not focus on organisational context but only on generic strategies of differentiation, cost leadership or focus strategy.

<sup>18</sup>Abernathy and Clark, 1985 and Christensen, 1997 explain frameworks for innovation types and their impact on organisational strategy. Although they provide contingency models, they do not develop recommendations for organisational activities but remain on strategy level.

<sup>19</sup>von Hippel (1978) distinguishes between a manufacturer active paradigm and a customer active paradigm in innovation processes. He develops organisational recommendations and founds them on empirical findings. However, he does not relate his findings to external contingency factors.

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Abernathy/Utterback (1978)	Develop a model that explains innovation types and stimuli by product and development stage. While in the earlier stages product innovations dominate within an industry, process innovations increase in later stages. They see product innovations first driven by technology, then followed by user needs. Process innovations are first induced by technology, then driven by cost reduction objectives.
Damanpour (1991, 1996)	Analyses organisational contingency factors like specialisation, differentiation, centralisation and other factors, and their effect on organisational innovation. In a second study (1996), he analyses the impact of organisational complexity on innovation.
Drejer (2002)	Management of Innovation in three situations, exploitation of existing technologies, stable technological change, disruptive technological change, develops different foci for innovation process organisation, technology integration, strategic technology planning, organisational change and business development.
Ettlie/Rubenstein (1987)	Research the impact of organisational size and product innovation success. They develop organisational and process related recommendations for successful product innovation.
Galbraith (1982)	Analyses the task of innovation in the context of development stage and strategy. He describes and develops recommendations for variables of organisational structure of innovation processes.
Hobday (1998)	Analyses the influence of product complexity on organisational form. Distinguishes two ideal types of innovation schemes: conventional mass production and complex products and systems innovation.
Mone et al (1998)	Analyses the effects of organisational maturity on innovation output. They explain whether organisational decline inhibits or stimulates innovation along environmental, organisational and individual variables.
Pavitt (1984)	Analyses the effect of industrial sector on innovation patterns. He distinguishes supplier dominated, production intensive, specialised equipment suppliers and science based innovators. These innovation types are characterised by sources of technology, requirements of users, and possibilities of appropriation.
Sørensen/Stuart (2000)	Investigate the relationship between organisational maturity and innovation processes.
Souder et al (1998)	Analyse the effects of environmental uncertainty and organisational integration on product development effectiveness.
Teece (1986)	Develops a framework for the analysis of the external environment (appropriability regime), and assets necessary for system innovation, and their impact on the decision of organisational integration or contract development.
Teece (1996)	Analyses the effects of organisational structure on the generation of new technology. He distinguishes silicon-valley type, multi-product integrated, alliances, and virtual organisations.
Tidd (2001)	Develops a theoretical framework that describes effects of environmental contingencies on degree and type of innovation, on organisational configuration and finally on organisational performance.
Tushman/Anderson (1986)	Research the impact of technological discontinuities on organisational strategy, competences, and growth rates.
Tushman/Nadler (1986)	Analyse the tasks and activities in innovation management and develop recommendations for organisational design for innovation processes.

**Table 4: Recent approaches from a contingency perspective on innovation, developed by the author.**

**The task of innovation problem solving will be used as a basis for the theoretical framework.**

A closer look at the approaches presented in the table shows that the following points attract attention. There is no common structure of analysis or framework for the analysis of contingent factors in defined contingencies. This may be because the contingency view has developed out of systems theory and sees organisations as open systems (Morgan, 1997). Thus, there is no beginning or end in changes of the environment and the organisation. As a result there can be no general framework as this would not accommodate the system's complexity. Another issue is more challenging: The existing approaches relate to the environment, the strategy or the organisation itself as contingencies, only few make the link from a task (Galbraith, 1982; Tushman/Nadler, 1986; Picot, 1993) to organisational consequences. However, these approaches are vague in their description of the conceptual problem solving task of innovation concept generation, as they only focus on organisational variables and do not make the link from strategy to task explicit. The main task in the early stages of innovation processes is strategy and product/service conception and this is not sufficiently explained to date, as the link from strategy to product conception has not yet been modelled. Only if this link can be established can requirements for method selection in different situations be derived.

#### **4.4 Summary.**

In this chapter, the relationship between innovation, strategy and organisation has been explored. Further, on the basis of decision making and problem solving theory, the concept of methods for the pre-project innovation phase has been developed. In the final step, on the basis of the contingency view, the concept of organisational situations has been explained.

Strategy, organisation, and innovation concept generation condition each other: Strategy is developed by and within an organisation, the innovation concept follows the innovation strategy and it has to be implemented by and within the organisation (see chapter two). Strategy is the frame for development and selection of means which generate economic advantage for an organisation. In this sense, innovation strategy defines the frame for the creation of means that are novel and open for economic exploitation (see section 4.1). In its early stages, innovation concept generation overlaps with strategy development, which makes this task unstructured and highly ambiguous: organisational strategy and capabilities have to be matched with requirements defined by the strategy and given by the environment.

This process of matching capabilities can be seen as an organisational problem solving or decision process, because the process ends with a decision as to whether to conduct the defined innovation project or not (see chapter two, and section 4.2). Decision processes consist of the activities of objective definition, alternatives generation and evaluation, the act of choice, and implementation (Harrison, 1995). In the ideal case of the rational school of thought (Lord/Maher, 1990), objectives are clear, alternatives can be developed because information is available, and choice is also clear due to well-defined alternatives and clear decision rules. However, the decision process is a cognitive process, and the environment is uncertain and ambiguous. Thus, the development of clear and consistent objectives, the development and evaluation of alternatives, and the act of choice are a problem of communication, availability of information, and limited information processing capability (see section 4.2). In this sense, methods can facilitate the pre-project innovation problem solving process by supporting information collection, processing and communication by providing structure. The innovation pre-project problem consists of a strategic problem and an innovation problem. The innovation problem in its first order is the question about the products or services that satisfy the customers' needs (the concept question). In its second order, the problem can be analysed on an organisational level and on the conceptual level. While the organisational level has been researched extensively, so far (see chapter two), the conceptual level and thus the question of methods has been left unregarded in the context of organisational situations.

Contingency theory has its roots in systems theory, and assumes that organisations adapt according to the requirements defined by its strategy, task, structure, and the external environment (see table 3). In the original approaches to contingency theory, the dependence of organisational structure to contingency factors was researched, like the uncertainty of the external environment (Burns/Stalker, 1961; Lawrence/Lorsch, 1967), or organisational technology (Woodward, 1965). In its basic sense, the contingency approach is based on if-then relationships, meaning the effect of contingencies on contingent factors. Newer approaches, which rely on a greater variety of constructs, a certain complexity, and focus on organisational circumstances in the context of innovation, to date only have organisational or strategic factors as research objects. The conceptual and method level has not been subject to any research in the context of pre-project innovation processes and organisational situations. As a precondition for the selection of methods depending on the organisational situation, the link between strategy and concept generation has to be established.

The contingency approach can be seen as an appropriate frame for the evaluation of the selection of methods in early innovation phases, although it has never been applied on this level. In the next

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steps, the concept of methods in pre-project innovation processes will be further researched in the context of innovation strategy and organisational situations. For this purpose, a theoretical framework will be developed for the description and evaluation of methods in pre-project innovation processes depending on the respective organisational situation.

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In this chapter, methods were defined as means to facilitate information collection, processing and communication. Therefore, in this chapter the research objective was refined by this definition. In order to reach the overall objective, objective 1 of this research is to develop a theoretical framework for the conceptual analysis and description of the fuzzy front-end of innovation processes. In this chapter, the necessary basis for the development of a framework was developed.

## 5 Towards a Theoretical Framework.

*Chapter aims: In this chapter, it is my objective to develop a theoretical framework for description, understanding, and evaluation of the selection of methods for pre-project processes in different organisational situations, and to develop research propositions for further empirical investigation. My framework will be based on the concept of innovation problem solving in different situations.*

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In order to reach this overall objective, sub-objectives 1 and 2 of this research are to develop and operationalise a theoretical framework, and to derive propositions. To meet these objectives is the aim for this chapter.

In the previous chapters, the research field of innovation management in its early phases was introduced. A research gap has been illustrated on the conceptual level, and it has been shown that to date there is no theory that explains the selection of methods in the pre-project innovation phase dependent on an organisational situation (see chapter 2.5). Existing approaches to facilitate the strategy-method-concept link are either very specific to an organisation (see chapter 2.3), or context-free, like creativity techniques or problem-solving heuristics (see chapter 2.4). The theoretical concepts for the description, analysis and explanation of method selection in different organisational situations have been introduced. The relationship between innovation strategy and concept development with business strategy has been explained (see chapter 4.2), and it has been shown that the concurrent development of strategy and innovation needs to be facilitated, as they both determine each other (see chapter 2.3, and chapter 4.2). The perspective of decision-making and problem-solving has led to the concept of methods (see chapter 2.3, and in particular 4.3). The application of the contingency view in this context can help to define organisational situations that determine requirements for method selection and thus reduce complexity for analysis (see chapter 4.4). To date, the contingency view has not been applied on the strategy-method-concept link, but only on the strategic or organisational level. As a result, in this chapter, the basic theoretical framework for description, analysis and explanation of the selection of methods in different pre-project innovation situations will be developed. First, four different generic situations will be described and the first basic propositions will be derived. Then, the activities in pre-project innovation processes will be introduced in order to derive variables for description, and more refined propositions will be developed. Then, methods for pre-project innovation processes will be operationalised in the context of organisational situations and activity modules, leading to the final propositions. As a result, in the final step, propositions will be developed for the selection of methods in different organisational situations.



## 5.1 Contingencies for Generic Organisational Situations: Problem Dimensions and Innovation Focus.

As seen in chapter 4.4, the contingency view has been widely applied in the context of innovation management. However, the existing approaches are not suitable to describe and analyse the use of methods in different situations. This is due to the reason that existing approaches of the contingency view in the context of innovation management remain general and unspecific in the description of the tasks (see section 4.4). The task in the early stages is to solve the innovation problem, which is the second order problem of the strategy problem (see section 4.3). In table 4 (ch. 4), an overview of current approaches to applying the contingency view in the context of innovation management has been provided. In particular the approaches by Galbraith (1982), Tushman/Nadler (1986), and Picot (1993) focus on the organisational task in order to develop recommendations for organisational structures. The organisational task constitutes the first order problem to be solved, and the organisational structure and the conceptual problem are the two second-order problems of how to solve the first-order problem. As a result, the methods on the conceptual level have to be derived from a strategic situation. Existing recommendations remain vague for the conception of product or service innovations. Either, the theoretical frameworks remain on a general level (e.g. Tidd, 2001), the recommendations remain on a strategic level (e.g. Teece, 1996), or the derived situations are only used to describe patterns, but not to derive organisational or conceptual recommendations (e.g. Pavitt, 1984). As a result, the link between the actual first-order problems and second-order problems has only been approached incompletely or in isolation. According to Tidd (2001), it is one of the primary tasks of contingency research to identify the dominant contingencies that influence the organisational situation. In consequence, the shortcomings can be addressed by two measures: first, the link between a strategic situation and the conceptual problem solving process has to be made, because this results in a more detailed and accurate description of the task. Further, the external contingencies which influence the innovation process the most have to be grouped into a consistent framework of concrete contingencies.

In section 4.3, criteria have been developed that enable evaluation of whether theory can be said to follow the contingency view or not. To develop a theory that can follow the contingency approach, the influence of environmental contingencies on an organisation has to be addressed by using models of a certain complexity. Here, the focus will be to evaluate the influence on the conceptual problem solving task.

As a result, in the following section a consistent set of contingencies will be developed to describe organisational situations in order to make the description of organisational contingencies manageable. These situations have to be derived by those contingencies with the strongest impact on the problems to be solved.

The first objective is to develop contingencies that describe organisational situations. These organisational situations can be derived either from theory or from empirical data. In this research, the organisational situations are part of the theoretical framework for evaluation and the development of hypotheses. Here, the consistent set of contingencies to describe organisational situations will be derived from theory in order to be evaluated by empirical investigation in a later stage of theory development. This decision has been made for several reasons. First of all, the research gap has been developed on the basis of an analysis of existing literature. It has been identified by the combination of three theoretical research fields: Innovation management, decision making and problem solving, and the contingency perspective. In all these three areas of research, the research objects and constructs are not completely directly observable, and functional relationships between the numerous variables have been discussed. As a result, no common framework about the

## Towards a Theoretical Framework.

relationships of variables has been formed (see chapters 2.1, 2.3, 4.3, and 4.4). In addition to the lack of direct observability, the research topic is of high complexity. Consequently, the risk of developing a framework of limited validity would have to be compensated by a highly complex operationalisation, derived from in-depth case study analysis, and a very large number of cases in order to ascertain a certain generalisability and comprehensiveness of the framework (Yin, 2003, see also chapter 3). This research project aims to develop theory as a basis for further research. The described research fields all have a long tradition, and thus the theoretical basis can be considered as strong enough in order to develop a strong and robust theoretical framework. In their reviews of theory and empirical research in innovation management, Tidd (2001) and Ernst (2002) criticise the weak theoretical grounding of existing empirical research because of the high complexity of the research field and the resulting lack of generalisability and validity (see chapter three). In order to develop perspectives that generate new, at first not directly observable insights, a framework of analysis for the selection of methods in different organisational situations will be derived from theory. In the subsequent steps, propositions will be developed which will be evaluated and validated empirically in a later stage of the thesis. This will provide a typology of organisational situations different from those that already exist, but have not been able to explain different requirements for the selection of methods in pre-project innovation phases.

### **Basic theoretical reflections for the development of organisational situations.**

In this section the objective is to develop a framework for the description of organisational situations on the basis of limiting contingencies. The aim of such a framework must be to reduce the complexity of the research environment in order to develop conclusions on a more general basis (Tidd, 2001). In order to achieve this, the variables describing the environment will be described along a limited set of dimensions which are independent of each other. The most dominant contingency factors can co-describe other dimensions and a redundant description can be avoided. As a result, focus will be on those contingency factors that can only be changed long-term. Short-term factors will not be considered as contingencies, because they can be changed and thus do not determine the situation, but can be regarded as variables for managerial intervention.

Methods are used to facilitate problem solving processes (see chapter 4.3). The strategic problem (the first level problem) for an economic organisation is to generate profit (e.g. Besanko et al, 2000). The innovation problem is the question of how to generate profit by novel concepts. The basic equation for profit is defined as:

$$PROFIT = SALES * PRICE - COST$$

The total profit of an economic actor is defined by the sum of all products:

$$PROFIT = \sum_1^n SALES_n * PRICE_n - COST_n$$

This equation reduces the problem to a very basic perspective, and many factors are not considered. For example, general costs like overhead expenses are not included. However, the equation clearly describes the three basic approaches for intervention through innovation projects: in order to increase profit either a new product can be introduced, the product of sold units and price (sales turnover) can be increased or costs can be reduced. These approaches are also reflected by the categorisation of product/service innovation and process innovation (see chapter 2). This research focuses on innovation directly related to the value of products and services and thus process

innovations are only of interest as long as they directly influence product features that determine the product value (see chapter 2). Now that the basic equation of profit is defined, the next question is to define the factors of influence on sales turnover and costs.

Sales turnover can be influenced by a variety of factors. First of all, the market potential needs to have a certain size, because it is defined by the number of potential customers and their budget for purchasing the product (Besanko et al, 2000). The relative market share is the realised sales turnover of an organisation in relation to their competitors. Thus, sales turnover is determined by the customers' budget and by competitive factors, like market entry barriers, for example (Porter, 1980), or by the ineffectiveness of the sales organisation. Sales revenue can be maximised by optimising the function of price and sold units. This is determined by the customers' reservation price and price elasticity of demand, which implies that customers are price sensitive and are not willing to pay any price for the product (Besanko et al, 2000). Consequently, in order to raise a price, the problem-solution offered by a product or service has to be improved. As a result, competitive and ineffectiveness factors only constrain sales revenue, which is determined by the customer needs and the problem-solution offered by the product.

In order to produce goods and services, an economic actor has to organise this process. Costs can be categorised by fixed and variable costs, or by costs defined by their origin, like production costs, marketing costs, or personnel costs. Another type of costs are transaction costs. They are defined as costs for information and communication, resulting from initiation, negotiation, settlement, adaption, and control of a service exchange between economic units (Wigand et al, 1997). Thus, transaction costs are typically the hardly measurable costs of collaboration and communication.

Using the levels of problem description, the innovation problem at its first level is to solve customers' problems by the means of products and services. The customers pay a defined price to purchase these means. The second level problem is divided into the organisational problem (as aforementioned) and the conceptual problem which defines the requirements for method selection. As a result, the customer problem directly defines the conceptual problem and thus has considerable influence on the selection of methods. Further, organisations delivering products or services often are embedded in a specific supply chain, depending on their suppliers and customers (Porter, 1980). In the context of a specific product, this supply chain cannot be changed as easily as internal processes could be, because these are located within the organisational boundaries. As a result, the two dimensions of customer problem-solution and collaboration can be identified as strongly determining the organisational situation. In the following two sections, these two dimensions are further illustrated.

### **Dimensions for organisational situations: customer problems and needs.**

The importance of identifying and satisfying customer needs has been widely recognised, as the works of numerous authors show (Holt, 2002; Kano, 1995; von Hippel, 1989; Hauser, 1984; Burns/Evans, 2002). According to Holt (2002), customer needs can be explicit or implicit (see chapter 2), and they are a necessary condition for innovation success (Danneels/Kleinschmidt, 2001). As a result, a wide variety of approaches to describe or understand customer needs has been developed. Authors deal with customer expectations (Kano, 1995; Hauser, 1984), customer delight (Burns/Evans, 2002), or the prediction of future customer needs (von Hippel, 1989). However, the basic concept of a customer need is not explicitly described in most of the literature dealing with product development. One of the best known models of human needs has been developed by Abraham Maslow (1943; 1987). He distinguishes physiological needs (like food or sleep), safety (like security or protection), social needs (like love or belongingness), esteem (like self-respect or status), and self-actualisation (like growth or advancement). According to Maslow (1987), these needs have to be satisfied in this order, and while physiological needs, safety, social needs and esteem are

Towards a Theoretical Framework.

reduced with satisfaction, Maslow assumes that self-actualisation needs increase with further satisfaction. Further, once lower level needs are satisfied to a certain degree, the next higher level needs have to be satisfied. This hierarchy of needs has been strongly criticised, because Maslow's insights are partially based on research conducted with primates (Cullen, 2000), and additionally the results focused on individuals of North-American culture in the 1940s and thus is not directly compatible to other cultures and today. Further, Cullen (2000) points out that the needs are defined by biological characteristics, and thus are different from individual to individual. As a result, the hierarchy of needs can be regarded as outdated. However, the categorisation of needs is still widely accepted as comprehensive and is still applied (Mullins, 1999), while the hierarchy of needs is ignored.

In order to satisfy needs, products deliver benefits to the customer (Meyer, 1996). Kotler (2001) describes products as packages of benefit, not just products with a certain use. Meyer (1996) distinguishes four kinds of benefits: Basic benefits, personal benefits, social benefits, and magic benefits. The basic benefits are the actual basic application of the product, personal benefits are specific benefits to the individual customer, social benefits evolve out of the interaction of the customers with their social environment, and magic benefits are benefits of a non-rational or emotional kind. Key result of these reflections to illustrate is that customer needs can be described by several dimensions, and that they can vary in specificity from customer to customer. The following table sets needs and benefits into relation and thus illustrates how products potentially satisfy needs.

**Conceptual space for customer problem-solutions.**

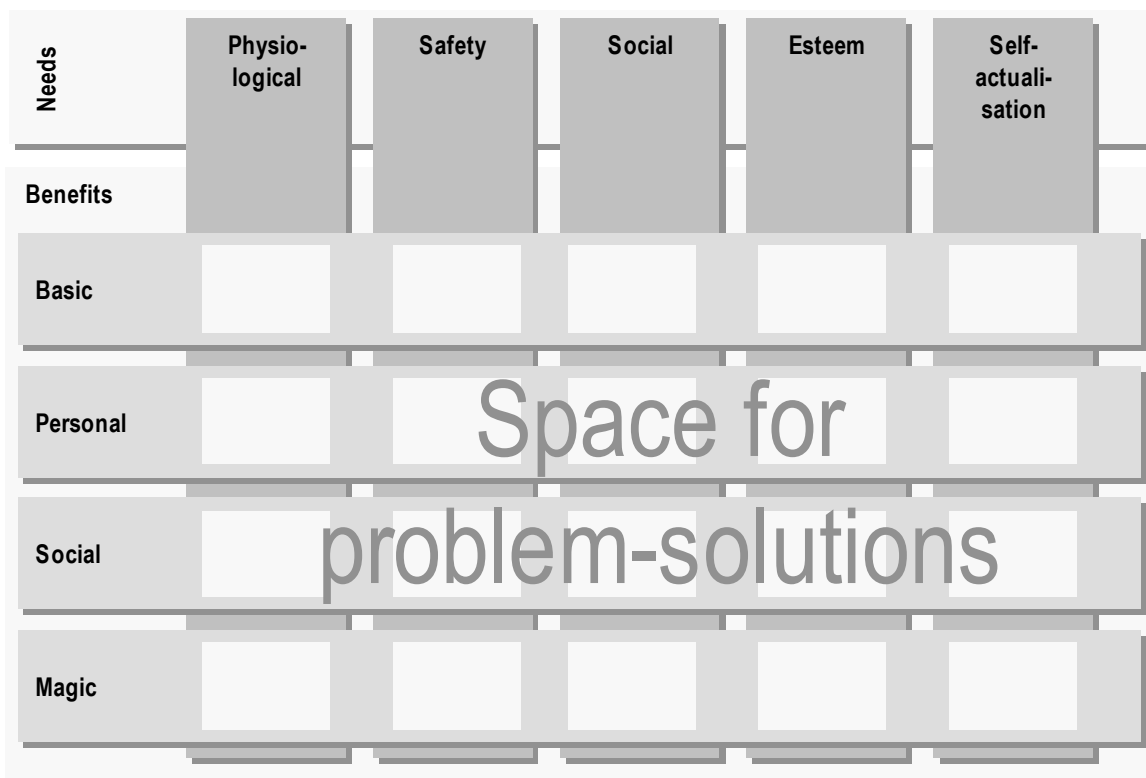


Figure 17: Conceptual space for customer problem-solutions, developed by the author on the basis of Maslow (1942) and Meyer (1996).

This categorisation of needs and benefits focuses on individual end customers, and it is not directly applicable to institutional customers. However, organisations consist of individuals who share objectives and conduct processes and tasks to achieve organisational goals (see chapter four). In

addition to the limited rationality of individuals, the communication process for objectives definition makes the definition of institutional customer needs more complex. The clearer organisational objectives are, the clearer their needs can be expressed and therefore satisfied. Thus, individual and organisational needs are specific to the respective individual or organisation. As a result, the categorisation of needs and benefits can be applied to individuals, organisations and individuals in organisations. For example, organisations also have physical needs, like certain products as process input. They need to assure the safety of their resources, they have to be socially integrated and they need to achieve a certain image. In addition, organisations can also have the need to grow (analogous to self-actualisation).<sup>20</sup>

Imagining a product or service and trying to complete the table with needs and benefits, the example will soon turn out to illustrate that it is hard for a single product or service to satisfy all individual needs at a time. A further result will be that one single product or service has the potential to satisfy more than one need to a certain degree by a range of benefits. As a result, the problem solving process of an organisation is determined by the degree of customer problem-solution. The more needs there are to be pleased, and the more complex the needs are, the more complex the problem solving process has to be. The less a customer need is satisfied by the product or service, the less complex the problem solving process needs to be.

#### **Dimensions for organisational situations: Collaboration and transaction costs.**

Some products are of higher complexity than others. Due to this product complexity, organisations have to collaborate with other organisations, or they have to purchase pre-manufactured parts of the product or service. This collaboration and the emergence of a supply chain can be explained by transaction cost theory (Williamson, 1975; 1985; 1993), the effects result in co-specialised assets (Teece, 1986), and a position in the supply chain (Porter, 1980). In the following, these three concepts are going to be introduced.

Transaction costs are costs for collaboration and communication, as described above. Transaction cost theory has a normative character and describes the question as to whether a good or service should be produced within an organisation or be purchased from the market, the so-called vertical integration, or the optimal organisation form (Wigand et al, 1997). Transaction cost theory consists of three basic concepts: assumptions about individual behaviour, assumptions about the environment, and the transaction atmosphere. In contrast to neoclassic market theory, transaction cost theory assumes asymmetrically divided information and opportunistic behaviour, which implies that the organisational form acts as a surrogate of trust. Opportunistic behaviour implies that actors always optimise their benefit, even if they cause disadvantages to their contract or co-operation partner. In addition to opportunistic behaviour, bounded rationality of actors aggravates the problem of environmental uncertainty, and thus, due to asymmetric information distribution, actors can generate economic benefits due to their position. In addition to environmental uncertainty, the specificity of assets and the products and services to their intended use is an important factor for the question of whether to integrate the service into an organisation or to trust in the market as a co-ordination mechanism. Further, the frequency of interaction determines the importance of the related goods and services. To summarise, transaction cost theory recommends vertical integration the more specific, the more frequent, and the more strategically important a good or service is, because otherwise the transaction costs for a market solution would rise too high to be economically efficient. Transaction cost theory has been widely criticised for several reasons, but especially for the positivist assumption of opportunism and for a lack of consideration for human interaction (Ghoshal/Moran, 1996). Ghoshal and Moran (1996) focus on the normative character of transaction cost theory and

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<sup>20</sup> See e.g. Kotler/Keller (2005) for an extensive discussion of organisational buying behaviour.

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argue that the assumptions of the theory lead to dangerous prescriptions, because of the assumption that opportunistic behaviour can be compensated by hierarchical integration, which is realistically not to be determined by pure theoretical considerations. Although prescriptive and normative elements of transaction costs are criticised, the descriptive and explanatory value still remains to a certain degree. The main conclusion from transaction cost theory is that organisations collaborate on a market basis or vertically integrate with each other for efficiency reasons under the prerequisites of environmental uncertainty, strategic specificity and frequency of interaction.

In his competitive analysis framework, Porter (1980; 1985) distinguishes five forces that influence or determine the frame of action for an organisation in a supply chain position: their direct competitors try to offer better and cheaper products, substitutes try to solve customer problems in a different way, market entrants try to increase competition, and suppliers and buyers set them under pressure with their bargaining power. This bargaining power can result from a source of strategic influence, like strategic assets, or a specific, advantageous position. In the context of innovation, Teece (1986) distinguishes three different types of complementary assets, which can be seen as specific assets in the context of transaction cost theory or as sources of strategic influence in the sense of Porter. If innovators plan to introduce a technological innovation, they have to consider the adaption of co-specialised assets that are important for the success of the respective innovation. Generic assets are unspecific and do not need to be tailored to the planned technological change. Specialised assets can either depend on the planned innovation, or vice versa, and co-specialised assets depend on each other.

As a result, collaborating innovators always have to consider the supply chain surrounding them for assets complementing their own products and services. This leads to the conclusion that the more that supply chain collaboration is necessary for innovation, the more complex the innovation problem will be. This complexity of production of goods and services depends on the degree of collaboration and co-specificity of assets. In consequence, the complexity of production of goods and services has an influence on the innovation problem and thus on the selection of methods. Complexity of production of goods and services is considered a long term factor, because a move in the supply chain either implies considerable transaction cost inefficiency, or is inefficient due to inefficient organisational specialisation or missing strategic assets. Thus, a supply chain can only be changed in the long run or by developing a completely new product.

### **Organisational situations for the selection of methods.**

In the two sections above, two major dimensions of influence for the description of organisational situations have been introduced. In order to develop a framework of consistent sets of contingencies, these two dimensions have been selected due to their relative independence from each other, and because they represent the two major approaches for innovation: Sales revenue is limited by the market potential which is defined by the degree of satisfaction of customer needs, and costs are externally delineated by collaboration. Internal process costs can be ignored, for two reasons: First, internal processes can be changed with comparatively less effort and further, process innovations are not the subject of this research unless they are conducted in order to shape the product or service. Thus, these two dimensions are considered as sufficient in order to avoid unreasonable complexity but they also assure sufficient explanatory potential of the model.

In order to describe organisational situations, the dimensions are considered as continuums of values, which implies that two extreme values of variables are used to describe ideal types. These ideal types of organisational situations are described by two problem dimensions: The degree of customer problem-solution, and the complexity of collaboration for production of goods and services. Both these dimensions can be the focus of innovation problem solving. Combined with each other, and assuming each of the two extreme values as descriptive for an ideal type situation, there are

four situations evolving: In situation one, the problems of customers are highly considered and their needs are individually pleased, and collaboration complexity is relatively low. In situation two, the problems of customers are less considered, and their needs are not individually pleased, and collaboration complexity is also low. In situation three, the problems of customers are less considered, and their needs are not individually pleased, but collaboration complexity is high. In situation four, the problems of customers are considered comparatively higher, and collaboration complexity is high too.

In this context, a situation relates to one specific product or service, not to a whole company. This implies that one company can be in more than one situation at a time. When it offers more than one different product. An organisational situation has to be understood as a snapshot of an organisation, its external and internal structure, and its strategy related to the specific product or service. Thus, a situation is always either a result of a process, or the starting point for further development. Within these constructed situations, ideal types of innovation problems are described. As a situation is the result of a development process, it is indifferent whether an innovation problem exists at the time of analysis, or whether it will exist in the future. As a result, each of these ideal-type situations can be analysed in isolation, and the requirements for development processes from one situation to another can be derived from a comparison of situations. In consequence, the implementation of new products and thus of a new supply chain can be regarded as aiming for one of these situations and will not be considered as an individual phenomenon. To summarise, the central construct of analysis will be the innovation problem solving focus of organisations in each of these different ideal-type situations. The innovation problem solving focus is defined as follows:

Innovation (problem solving) focus is the approach of an organisation to deal with pre-project innovation problem solving. The innovation focus depends on the organisation's situation, which is determined by where it is positioned on the two dimensions of customer need satisfaction and collaboration complexity.

The innovation focus is defined as the conceptual approach to innovation problem solving and thus directly determined by the innovation problem itself. The innovation problem determines the number of possible problem-solutions. As shown in chapter two, the innovation concept follows strategy and has to be implemented within the organisation. In early-stage innovation phases, strategy and innovation concept development overlap, therefore the innovation focus, which is determined by the problem, also determines the innovation strategy (see also chapter four). As a result, a well-defined innovation focus acts as a facilitating construct for the co-creation of strategy and innovation concepts by offering possible solution approaches for innovation problems. In consequence, the concept of innovation focus has the potential to accelerate and improve the effectiveness of pre-project innovation processes.

The following figure illustrates the four ideal type situations. In the following sections, propositions for innovation focus depending on the respective situation will be developed, and thus the figure will be concretely explained. The figure distinguishes four basic situations in order to make this under-researched topic more accessible in the first step.<sup>21</sup>

<sup>21</sup> The discriminatory power of the dimensions will also be discussed in chapter 6.3.1.

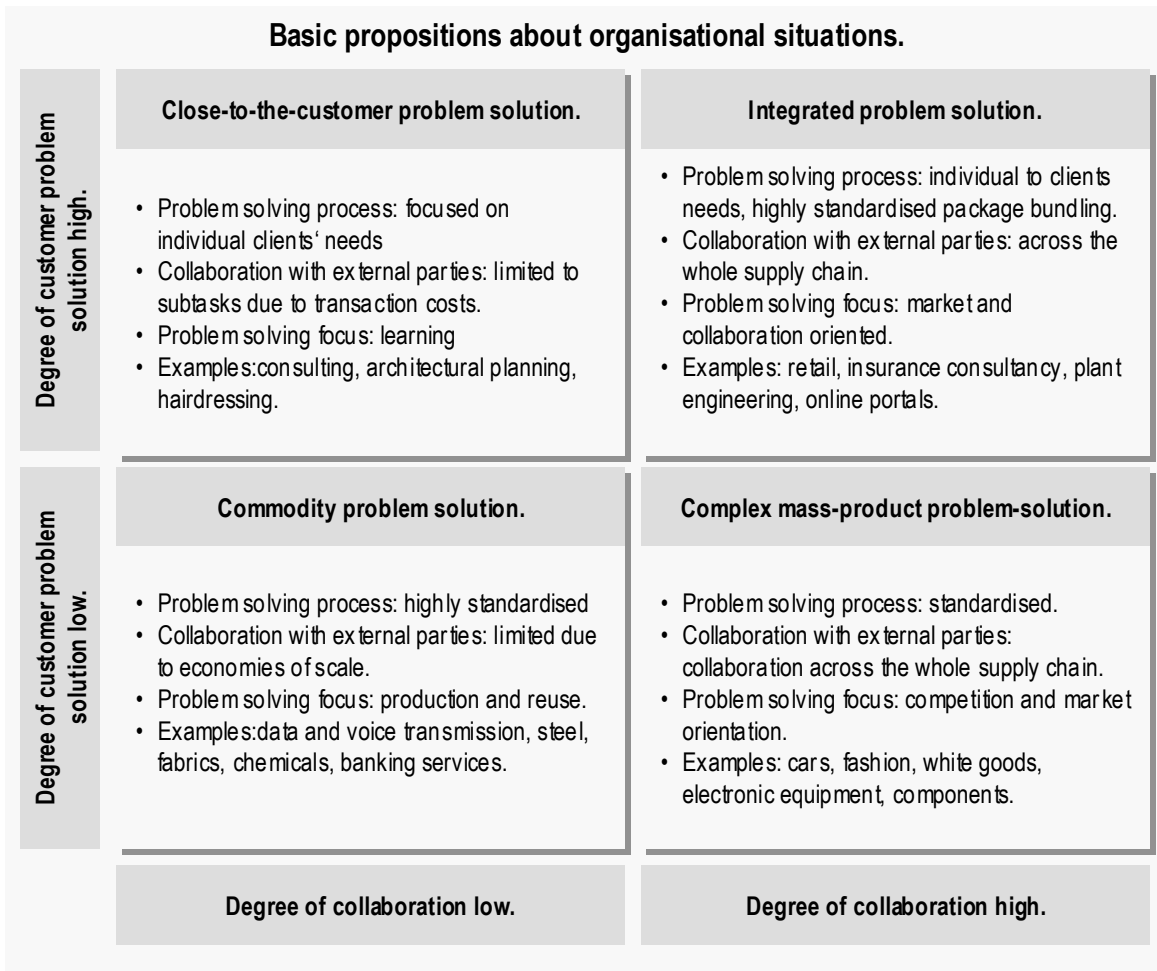


Figure 18: Basic propositions about organisational situations, developed by the author.

**Situation one: the close-to-the-customer problem-solution.**

In situation one, organisations aim to solve the customers' problems to a high degree. Because customer needs can be multidimensional (see figure 17), these problem-solutions have to be specific and individual for a customer. Of course, these problems can be standardised to a certain degree, however the individual problem-solution has to be generated in close interaction with the customer due to the high specificity of the problem. In some situations, customer problems are too complex or implicit so that even the customers cannot define their problems or the necessary problem-solutions themselves. Due to the specificity of the customer problem and because of the close interaction with the customer, the interface between the problem solving organisation and the customer is of limited capacity. This implies that collaboration with other problem solving organisations is limited to the specific process of customer problem solving. The focus in this situation is to solve an individual customer's problem, and thus every problem solving project is different to a certain degree. The problem-solution can be an individual service or a one-off product. The limited capacity for collaboration in the problem solving process does not imply that the problem solving process may be trivial. Quite contrarily, the high complexity may even require limited collaboration, because the objectives definition for problem solving is too complex for effective communication, and thus too complex for collaborative problem solving. At the other end of the continuum, close-to-the-customer problems can be simply too limited in their volume to require collaborative problem solving. To



summarise, transaction costs for objective definition or for internal organisation limit collaboration for individual customer problem solving. As a result, close-to-the-customer problem situations require individuals or relatively small teams who work very closely together, to solve a customer's problem in close interaction with the customer. One single problem is not the same as the one before, and thus problem solvers can only be prepared on a conceptual level for different problem types. Examples of close-to-the-customer problem solvers are business or legal consultancy services, architectural planning, artwork, hairdressing, plastic surgery, or chauffeur services.

**Proposition 1:**

The close-to-the-customer problem solving process is highly individual to customer needs, and collaboration is limited by transaction costs due to the high problem complexity, or due to the limited volume of workload. As a result, the innovation focus in this situation is proposed to be focused on the solution of individual customer problems and constrained by transaction costs. In consequence, innovations are developed by understanding customer needs and by transferring knowledge or idea components from one project to future projects. The innovation focus can be described as a learning focus: the problem solvers learn from earlier projects, about what the customer needs might be, and can offer problem-solutions in future projects. The other approach in the learning-focus situation is to improve the methods for problem-solution within projects (which differ from innovation methods).

**Situation two: the commodity-product problem-solution.**

In situation two, organisations support their customers to solve their problems themselves, and thus solve their problems only to a low degree. They provide a very standardised and undifferentiated product or service, for which collaboration with other problem solvers is not necessary. Here, predominantly the product price and quality differentiate competitors from each other, because emotional benefits only have short term differentiation potential in the context of this product or service. In this situation, customers know their problems very well and also how to solve them. This implies that the undifferentiated products serve as an ingredient or component for the first-level problem-solution of customers. In consequence, customers know very well how to process, use or apply the product or service, and they can clearly judge the effectiveness of the product or service. As a result, customers order the product or service to a specified quality as a precondition. As customers decide on problem-solutions using the criteria of specified quality, maximised efficiency, and minimised price, problem-solution suppliers have to be organised efficiently as well (see also Porter's (1985) cost leadership strategy). In order to be as efficient as possible, high investments in production technology are necessary in order to reach economies of scale. These high investments have to generate a certain return, which economic actors aim to optimise (Besanko et al, 2000). Economies of scale result in high specificity of production processes and in high frequency of production. As a result, transaction costs are minimised by less collaboration and increased organisational integration. To summarise, commodity problem solvers offer an undifferentiated product or service which is either of low complexity, or the high economies of scale lead to organisational integration. Examples of commodity problem solvers are data or voice transmission services, steel, fabrics, chemicals, or banking services.

**Proposition 2:**

The commodity problem solving process is highly standardised, and customer needs are clearly defined. The high standardisation leads to economies of scale investment to optimise process costs. Transaction costs are then optimised by organisational integration and reduced collaboration. As a result, innovation focus in this situation is limited by the investments for production services, and by the expressed and implicit customer needs. The innovation focus can be described as a focus on production and reuse: innovators aim for reuse of production technology for optimisation of investment returns, or aim for new or different applications of the existing product or service.

**Situation three: the complex mass-product problem-solution.**

In situation three, organisations offer solutions for more specific customer problems, but still to a relatively low degree. The specificity of the problem-solution is higher than for commodity solutions, but compared to customer needs, they only solve part of the problem. A mass product suits the standardised problems of a larger number of potential customers. The difference for commodity problem-solutions is, that customers do not exactly know their explicit problem definition, because of the relatively higher problem complexity. These more complex problems can be solved by standardised, but also more complex solutions. In this situation, customer needs are multidimensional (see figure 17), which induces the complexity and partial implicitness of customer problems. With increased solution complexity, but also reduced specificity due to solution standardisation, one mass product can be applied to solve different problems in different contexts. Thus, competition and differentiation potential are not limited to the benefits and needs pleased by the product. This uncertainty about customer needs aggravates competition, because the competitors' solutions may better fit to the customers' needs. With increasing complexity of problem-solutions, components of the solution become more specific. Thus, mass-product problem solvers have to collaborate with other organisations that supply components or commodities for processing. Here, vertical integration is determined by the whole array of requirements, including process costs, specificity, frequency, and strategic opportunities. To summarise, mass-product problem solvers offer a more complex product or service, which is applicable in different contexts in order to solve more complex, partially implicit customer problems. Examples of mass-product solutions are cars, fashion, white goods, home entertainment, sports equipment, or electronic equipment.

**Proposition 3:**

The mass product problem solving process is standardised, but requires collaboration with (co)-suppliers, customer needs are partially implicit, and the number of application contexts of one product is not limited to one. Competition is not limited to a specific set of benefits to solve specific needs. As a result, innovation focus in this situation is about finding out customer needs and making them explicit, and about defining products that please these defined needs, under the constraint of a specific supply chain. The innovation focus in this situation can be described as market and competition oriented: innovators aim to match defined market segments and products. Further, they are oriented at their competitors' activities.

**Situation four: the product-integrator problem-solution.**

In situation four, organisations solve their customers' needs to a higher degree than mass product problem solvers do. Similar to situation three, customer needs are partially implicit, and their problems are more complex. In contrast to mass-product problem solvers, product integrators adapt and process more than one different solution to fit to their customers' needs. In consequence,

solutions are mass-customised to customer needs and thus to a certain degree are specific and individual. Depending on the combination of mass products, close-to-the-customer services, commodities or other integrated solutions, the integrated solutions offered can be comparable and thus bear potential for differentiation. Hence, the mode of competition is dependent on factors different from those determining the integrator situation. However, due to the higher individuality, but also higher standardisation and the higher number of customers, transaction cost analysis will lead to the conclusion that market organisation is more efficient than vertical integration. Thus, product integrator problem solvers collaborate with a wide variety of different solution type problem solvers in order to bundle them together to provide an integrated problem-solution to the customer. For this reason, integrators have to be familiar with their customers' needs on the one hand, and with market offerings on the other. Examples of integrated product solutions are financial consultancy, retail, online portals, or complex project oriented business like plant engineering, or aerospace.

**Proposition 4:**

The product-integrator problem solving process is individual to customer needs with the limitation of necessary standardisation due to the higher number of customers and the relative complexity of customer problems. The higher standardisation of products leads to increased collaboration along the supply chain. Thus, integrators bundle solutions from other problem solving types in order to solve their customers' needs. As a result, problem solving in this situation is focused on understanding and making explicit customer needs and knowing the market offer. In consequence, the innovation focus in this situation can be described as market and collaboration oriented.

**Summary.**

Existing approaches following the contingency view do not describe or explain the reasons for selection of methods for innovation pre-project processes in different organisational situations. It has been shown, that for selection of methods, the task or problem itself has to be understood in order to find conclusions about appropriate method requirements. The innovation problem is the second level problem of the strategy problem, and it generates two second level problems itself: an organisational and a conceptual problem, of how to pursue innovation. As a result, innovation methods requirements are defined by the strategic problem. Thus, in this chapter four generic situations have been derived in order to provide different descriptions for innovation problems. The development of the framework was pursued from existing theory, because the theoretical basis was considered strong enough to develop a robust framework and was considered to be more promising than an empirical derivation due to the limited observability of the phenomenon.

The situations have been developed from the basic equation of profit, which is defined by sales revenue and costs. As a result, the two approaches for either increasing sales revenue or lowering costs can be identified, which is also supported by the distinction of product and process innovation. These two dimensions have been used in order to identify the two strongest and most independent variables for problem definition: degree of customer need satisfaction, and complexity of collaboration described by transaction cost theory. In order to make the model applicable and to allow more general conclusions, the number of dimensions has been limited to these two. Then, the dimensions have been used to describe ideal type innovation problems and resulting innovation focus. The concept of innovation focus has been introduced as determined by the innovation problem, which is defined by the strategy problem. Thus innovation focus defines the possible solutions for the strategy problem. As a result, the concept of innovation focus holds the potential of accelerating the problem of concurrent strategy and innovation concept development. The following

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table illustrates the difference between the concepts of different innovation focus types, and of process and product innovation, which can also be derived by the profit equation.

<b>Comparison of innovation focus and product vs. process innovation.</b>		
	<b>Focus on sales*price</b>	<b>Focus on lowering costs</b>
<b>Product innovation</b>	<ul style="list-style-type: none"> <li>• Add a new product to the portfolio.</li> <li>• Change product features to reach more customers.</li> <li>• Improve an existing product to raise price.</li> </ul>	<ul style="list-style-type: none"> <li>• Change product quality to allow price adjustment.</li> <li>• Change product as a result of changed processes.</li> </ul>
<b>Process innovation</b>	<ul style="list-style-type: none"> <li>• Introduce new procedures to improve product quality and raise price.</li> <li>• Apply “green” technology for ecological and image reasons to raise price and attract more customers.</li> </ul>	<ul style="list-style-type: none"> <li>• Improve production of goods and services to lower costs.</li> <li>• Improve co-operation to lower costs.</li> <li>• Improve basic technology or materials to lower costs.</li> </ul>

**Table 5: Comparison of innovation focus and product vs. process innovation, developed by the author.**

On the basis of the four ideal type situations, four different types of innovation focus have been constructed: learning focus in the close-to-the-customer situation, production and reuse focus in the commodity solution situation, market and competition focus in the complex mass-product solution situation, and market and collaboration focus in the integrator situation. At the beginning, it was shown that the task has to be described in order to derive requirements for method selection. Thus, in the next step the activities performed in the task will be further analysed in order to develop more detailed propositions for each of the four situations.

## 5.2 Activities in Pre-project Innovation Processes.

In the previous section, problem situations for innovators were described, and propositions for the resulting innovation focus were developed. In this section, the activities in pre-project phases are going to be further introduced, in order to set them in relation to the respective ideal-type situations. By proceeding in this way, the tasks of innovation problem solving in different situations can be further described and more precise propositions can be developed. Thus, it is the aim of this section to develop a frame for variables in order to prepare the development of consistent propositions for the appropriateness of methods in different situations. In the first step, an overview of pre-project activities will be given, to be followed by a more detailed description of each activity and propositions for the problem focus in the respective situations.

### **The pre-project phase can be described by synchronously conducted activity modules.**

As shown in chapter two, opinions and definitions of the precise beginning and ending of the pre-project phase differ. In this research, the pre-project phase is defined as starting with a first, deliberate activity of developing and evaluating a concrete business concept, and ending with a go/no-go decision about the resulting project. According to Holt (1978), a product concept is the fusion of customer needs and technological opportunities. This fusion model together with Rothwell's (1994) observation that process steps overlap increasingly, lead to the conclusion that it is not precisely explicable whether either customer needs (as problems to solve), or technological problem solving opportunities are the triggers for an innovation project. As a result, the pre-project phase (on the conceptual level) cannot be described as a process model, like for example Cooper's (1993) stage gate process, or Goffin et al's (1999) funnel and tunnel process. Both authors focus on the whole product development process and remain vague about the pre-project phase (see chapter two). To conclude, for this research the pre-project phase will be considered as a set of modules that are aggregated by performed activities, and it is not important which of these activities is the trigger for a new product or service concept, and which activities follow in which order. The activity modules are an analytical measure in order to make the pre-project phase accessible for description and analysis. They can be seen as categories of activities that have to be performed in an innovation pre-project phase.

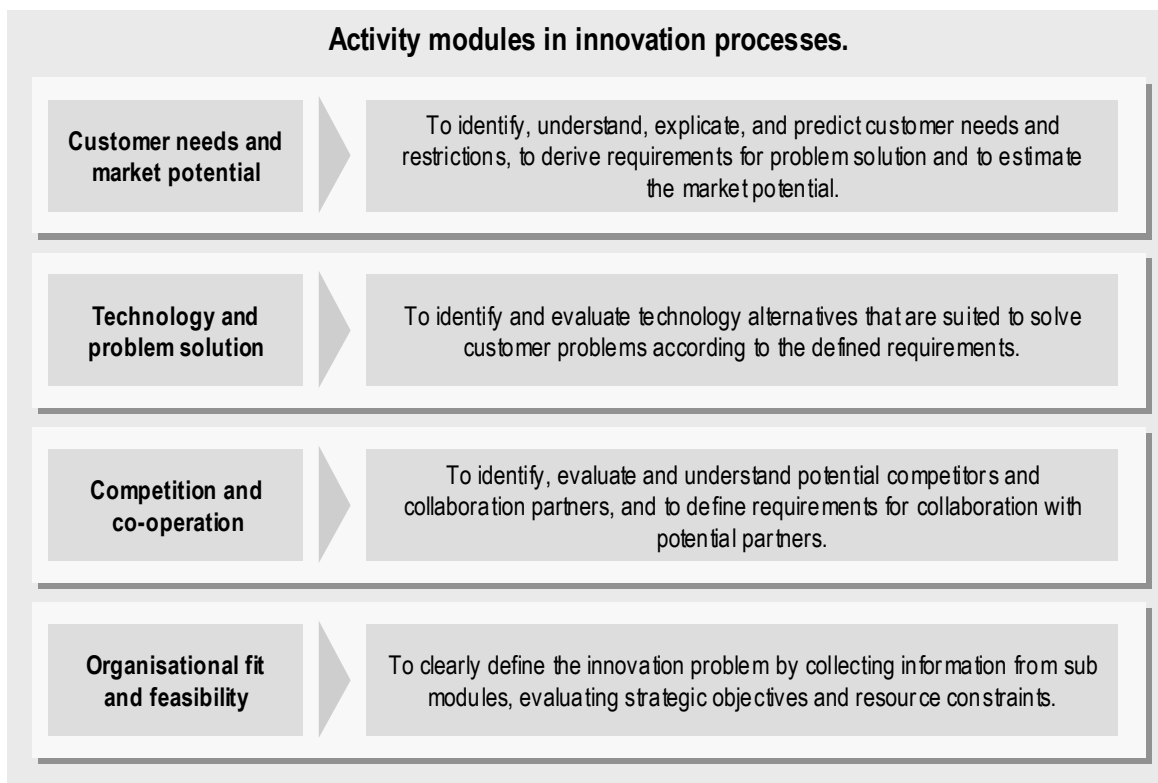
According to Cooper (1993), the task in the early phase comprises market research, user needs evaluation, technical and manufacturing assessment, and financial and business analysis. Further, the resource based view (e.g. Grant, 1991, 1991a, see also chapter four) concludes that resources of an organisation both enable and constrain the number of possible strategic opportunities. Further, innovation is a strategic measure in a competitive environment (see chapter 2) and it cannot be pursued in all situations without collaboration (see previous section). These observations lead to the following basic activity modules: Customer needs and market potential, technology and customer problem-solution, and competition and collaboration. The conceptual problem solving process takes place within an organisation, and in chapter 2.3 it was shown that the process of moving from a strategy to an innovation concept is highly individual to an organisation. In order to make activity modules accessible to analysis within organisations and their individual situation, a proceeding, feasibility and organisational fit module will be added. These four activity modules do not only apply to the pre-project phase, but to the whole innovation process. However, for the description of the pre-project phase it is particularly important to understand that these modules are conducted in parallel as modules of activities, because the pre-project phase is not a linear process.<sup>22</sup> In the following

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<sup>22</sup> See also chapter 2.3.

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sections, these four modules will be introduced, and propositions about the focus in the four generic situations will be developed.



**Table 6: Activity modules in innovation processes, developed by the author.**

**The customer needs and market potential activity module.**

As shown in the sections above, the existence of customer needs constrain the overall market potential. In order to solve customer problems, they have to be understood and described. However, the determination of customer needs is limited by several factors: First, customer needs are highly individual (specific) as it has been shown in section 5.1. Second, customer needs are not necessarily explicit, as prior research suggests (Trott, 2001; Fletcher, 1989; Beane/Ennis, 1987). As a third factor, customers may not be aware of their needs, as research by Goldenberg and Efroni (2001) suggests, which also affects the explicitness of needs. They have modelled the diffusion of the customers' awareness of their needs, concluding that often customers become aware of their needs when other customers also express their needs or buy a product that solves their needs. Von Hippel (1989) has developed the lead user concept. Lead users have need awareness earlier than other customers and they have a strong interest in getting these needs pleased by an innovative solution. As a fourth factor, customer needs may not even exist at the time an innovation is planned. Holt (2002) illustrates this fact by pointing out that customer needs are induced by environmental and contextual factors such as regulations or the consequences of applying other products. By providing a review of market segmentation techniques, Beane and Ennis (1987) address this problem by suggesting several contexts for segmentation, such as geographic, psychographic, demographic, behaviouristic, purchase occasion, benefit, usage incidence, user status, usage rate, loyalty, or image factors. Further, customer needs are not static. As environmental and contextual factors change, and because there is a time lag between need recognition and product introduction (see figure 2), there is a risk of invalid definition of customer needs and product requirements. As a result,

in the customer needs and market potential activity module, the main task is to understand, explicate, and predict customer needs and restrictions in order to derive requirements for potential problem-solutions and to estimate the market potential and implementation risk for the respective new solution.

To summarise, it has been shown that customer needs are multidimensional and individual to the customer. Further, customer needs may yet not fully exist or may not be explicitly described. Consequently, evaluating customer needs depends on the specificity of customer needs (how specific are the needs of one customer compared to other customers), the complexity of their need functions and restrictions, and to the degree of explicability potential explicitness of those needs.

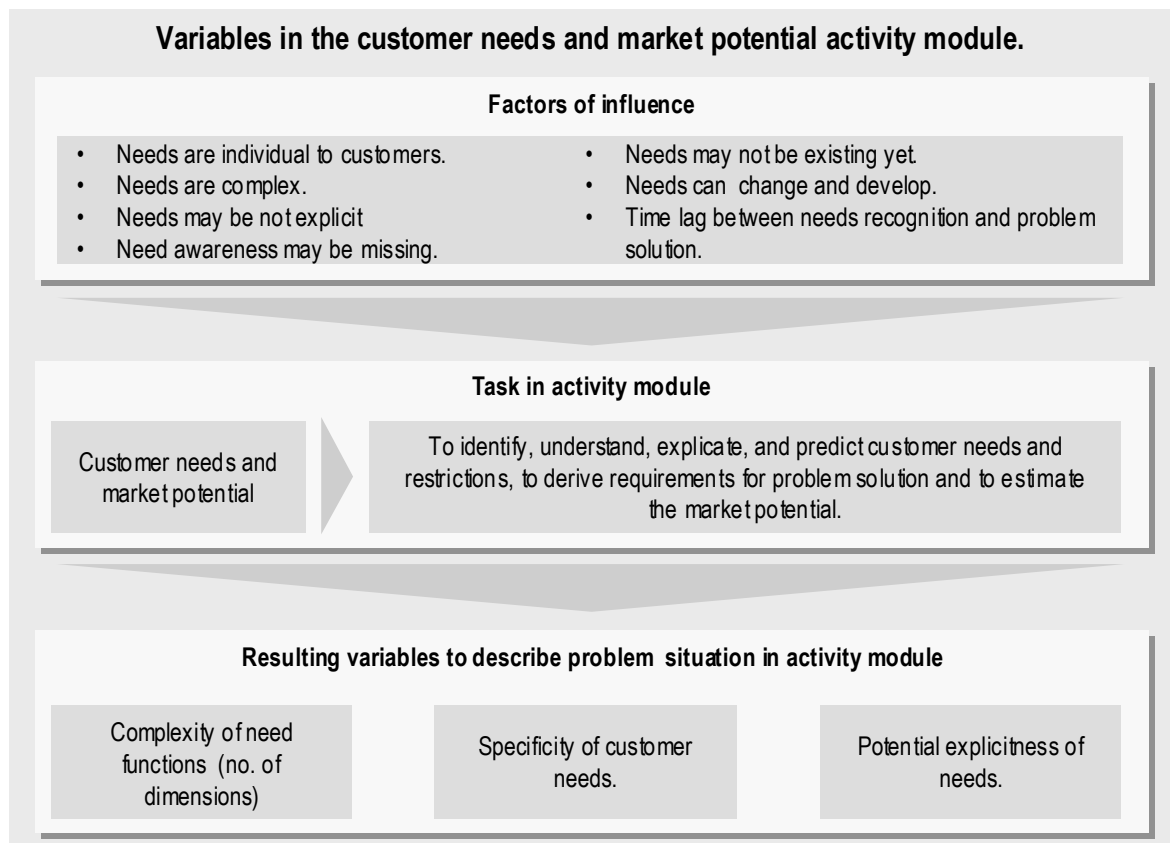


Figure 19: Variables in the customer needs and market potential activity module, developed by the author.

**The customer needs and market potential module in the close-to-the-customer situation.**

According to proposition one and the considerations above, the following proposition 1.1. can be derived.

In the close-to-the-customer problem solving situation, needs of customers are proposed to be complex, multidimensional and individual to the customer. Due to the specificity of customer needs, the customer problems can only be made explicit to a limited degree. As a result, the problem solving process is conducted in a project oriented way. This limits the number of potential customers for an organisation, because for the problem solving process, specific skills and experience are necessary.

**The customer needs and market potential module in the commodity-product situation.**

According to proposition two and the considerations above, the following proposition 2.1. can be derived.

In the commodity-product situation, needs of customers are proposed to be of low complexity and described by a limited number of dimensions. Variation of needs among customers is proposed to be limited, the customer problems can be described explicitly to a comparably high degree. As a result, the problem-solving process is highly standardised, which allows a very high number of potential customers.

**The customer needs and market potential module in the complex mass-product situation.**

According to proposition three and the considerations above, the following proposition 3.1. can be derived.

In the complex mass-product problem solving situation, needs of customers are proposed to be multidimensional and of comparably limited individuality among customers. Due to the multidimensionality of needs, explicability is limited because functional relations are unclear. As a result, the problem-solving process is highly standardised, and the problem-solutions aim to solve a range of customer problem dimensions. Due to the standardised problem solving process, the potential number of customers is comparably high.

**The customer needs and market potential module in the integrator situation.**

According to proposition four and the considerations above, the following proposition 4.1. can be derived.

In the product-integrator problem solving situation, customer needs are proposed to be multidimensional and of comparably higher individuality among customers. Due to the multidimensionality of needs, explicability is limited because functional relations are unclear. Due to the higher individuality, standardisation of problem-solving processes is limited. As a result, problem-solutions aim to solve a range of customer problem dimensions. The number of potential customers is limited by the standardisability of problem-solutions.



Propositions about the customer needs and market potential activity module.				
Degree of customer problem solution high.	<b>Close-to-the-customer problem solution.</b>		<b>Integrated problem solution.</b>	
	No. of need dimensions	Very high	No. of need dimensions	High
	Specificity of needs	Very high	Specificity of needs	High
	Explicability of needs	Very low	Explicability of needs	Low
	Resulting focus	Understanding	Resulting focus	Understanding
Degree of customer problem solution low.	<b>Commodity problem solution.</b>		<b>Complex mass-product problem solution.</b>	
	No. of need dimensions	Low	No. of need dimensions	High
	Specificity of needs	Low	Specificity of needs	Relatively high
	Explicability of needs	Very High	Explicability of needs	Low
	Resulting focus	Delivery	Resulting focus	Collecting
Degree of collaboration low.		Degree of collaboration high.		

Figure 20: Propositions about the customer needs and market potential activity module, developed by the author.

### The technology and customer problem-solution activity module.

Technologies and principles for problem solving represent the solutions of customer problems (Holt, 1978). They can be incorporated in products or services, or they can be implemented in processes of problem solving. Thus, in addition to representing the product solution, technologies are also part of the innovation problem-solution of an organisation. According to the problem-solution model presented in chapter four, technologies have to be identified as alternatives, they have to be evaluated according to the defined objectives (here the defined problem-solution requirements), they have to be made available and implemented in order to finally represent the problem-solution. This research focuses on the pre-project phase and thus the development of technology, and the actual availability and implementation are not subject to discussion in this thesis. However, in order to be implemented, technologies or process principles have to be identified and evaluated as potential problem solving alternatives. Further, technologies are not only identified on the basis of existing requirements, but also in order to evaluate them as to whether they can serve as a problem-solution to problems that have not been identified or do not yet exist. Technologies have different potentials for customer problem solving, they differ in performance that has to be optimised to fit to customer requirements (Adner, 2002). It has been shown that superior product technology performance has the potential to increase competitive strength (e.g. Foster's (1986) S-curve model), and also that inferior performance can disrupt a market structure and thus lead to new competitive structures

## Towards a Theoretical Framework.

(Christensen, 1997). Thus, the requirements determined by the customer needs become a relevant factor in relation to product technology performance. Further as a second factor, the role of technology in the problem solving process becomes relevant, as it influences technology acquisition. Pavitt (1984) distinguishes sources of product technology and sources of process technology, which are acquired from different sources depending on the sectoral role of an organisation. In this research, technology is considered either to be used in order to solve the customer problem itself, or to support or enable the problem-solving process.

To summarise, it has been shown that technologies have different features that help to solve customers' problems determined by defined requirements. Further, the role of technology for problem solving is relevant, as this determines the sources of technology. Consequently, the task of identification and evaluation of technology is determined by these two factors of role and features.

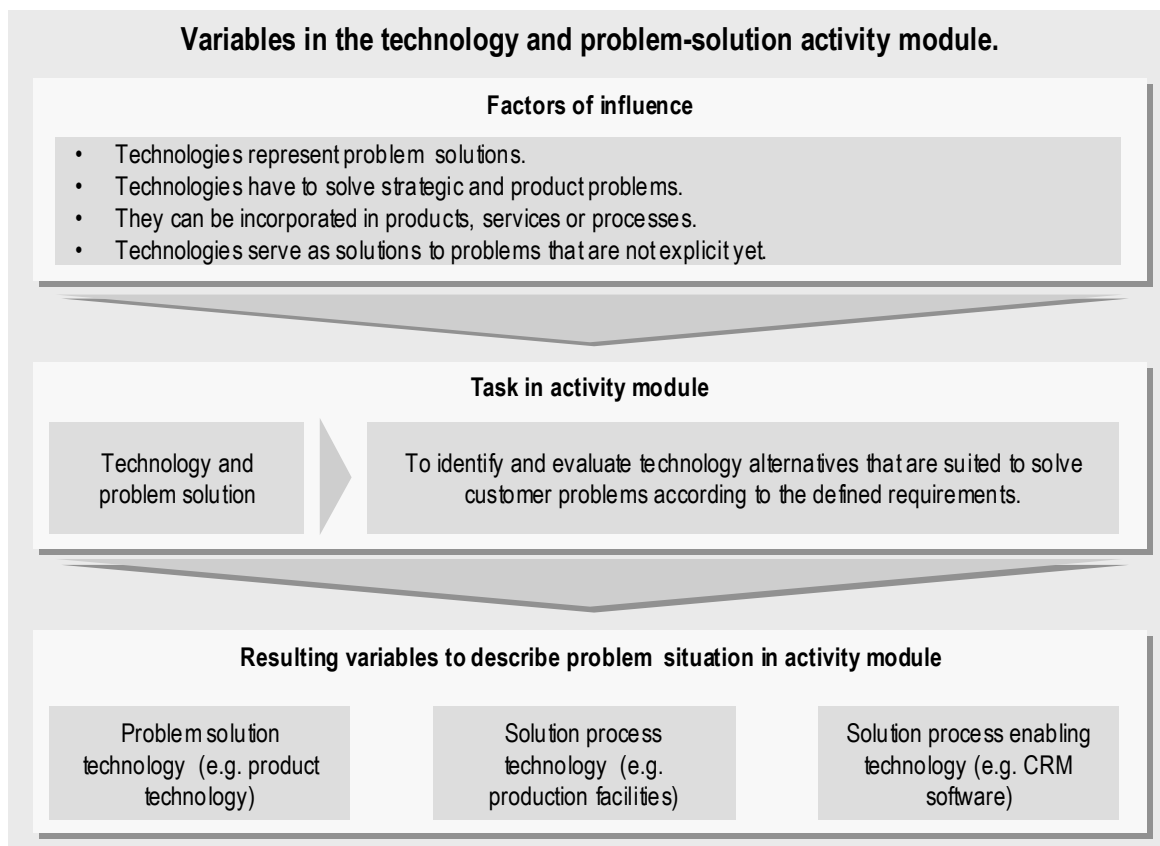


Figure 21: Variables in the technology and problem-solution activity module, developed by the author.

**The technology and customer problem-solution module in the close-to-the-customer situation.**

According to proposition one, 1.1, and the considerations above, the following proposition 1.2 can be derived.

In the close-to-the-customer problem-solution situation, the problem solving process is conducted in a project oriented way, which limits the number of potential customers for an organisation, because for the problem solving process specific skills and experience are necessary. Due to the high complexity of the customer need, the customer problems cannot be solved by pure technology. Thus, technology can serve as a supporting element for problem-solution or as a means to improve the problem-solution process. In this situation, problem solvers are in close interaction with their customers. Thus, the customer needs are present in the whole process. Due to this focus, technologies are searched for or identified that help solve customer problems. As every project is potentially different, due to transaction cost considerations, it is likely that problem-solution technology is mainly externally acquired, while problem solving support technologies or enabling technologies are externally acquired but also internally developed.

**The technology and customer problem-solution module in the commodity situation.**

According to proposition two, 2.1, and the considerations above, the following proposition 2.2 can be derived.

In the commodity-product problem-solving situation, the problem-solving process is highly standardised, and each problem-solution pleases a limited number of customer needs. This allows a very high number of potential customers which induces a scale-intensive business, as price, quality and availability become the most important customer need requirements. As a result, product technology plays an important role for the customers' applications of the product, and process technology determines the product quality. Due to the high investments into the scale intensive business, both problem-solution and problem-solving supportive technologies become comparably stable. Due to this focus, technology is evaluated in order to identify different application contexts of technology. As technology is located and maintained inside the organisation, reuse of both production technology and problem-solution technology are evaluated inside the organisation, also with external support.

**The technology and customer problem-solution module in the mass-product situation.**

According to proposition three, 3.1, and the considerations above, the following proposition 3.2 can be derived.

In the complex mass-product problem solving situation, the problem-solutions are highly standardised, and they have the potential to address a range of customer problem dimensions. The standardisation of problem-solutions allows a potentially high number of customers, which analogously to the commodity situation implies a certain scale intensity. However, due to the multidimensional customer needs and the multidimensional problem-solutions, various different contexts of use of the solution appear. In this situation, focus in the technology activity module is proposed to be between identifying new applications and features of technologies, and identifying alternative technologies that also solve customer problems adequately, in order to identify technological alternatives that generate competitive advantage. Thus, focus lies on competition and technological alternatives for both fields, problem-solving and problem-solving enabling technologies. Organisations in this situation are thus proposed to be connected to or involved in the technology development.

**The technology and customer problem-solution module in the integrator situation.**

According to proposition four, 4.1, and the considerations above, the following proposition 4.2 can be derived.

In the product-integrator situation, problem-solutions have the potential to address a range of customer problem dimensions, and the number of potential customers is limited by the standardisability of problem-solutions. In this situation it is the aim to address the individuality of customer needs by bundling standardised problem-solutions to fit customer needs. Similar to the close-to-the-customer situation, focus here is on solving a high degree of customer problems. Thus, problems of customers are solved by a project-like process, which is of less intensity as in the close-to-the-customer service situation. Due to this focus, organisations in this situation also search for problem-solutions that fit to their customer needs. The limited standardisation of problem-solutions leads to limited scale intensity. Thus, organisations in this situation are oriented to the market in order to integrate problem-solutions. As the problem-solution technology is provided by the problem solvers integrated in the offered bundle, problem solving process enabling technology becomes more important. As a result, organisations in this situation are oriented to the market and also involved in the development of enabling and integrating technologies.

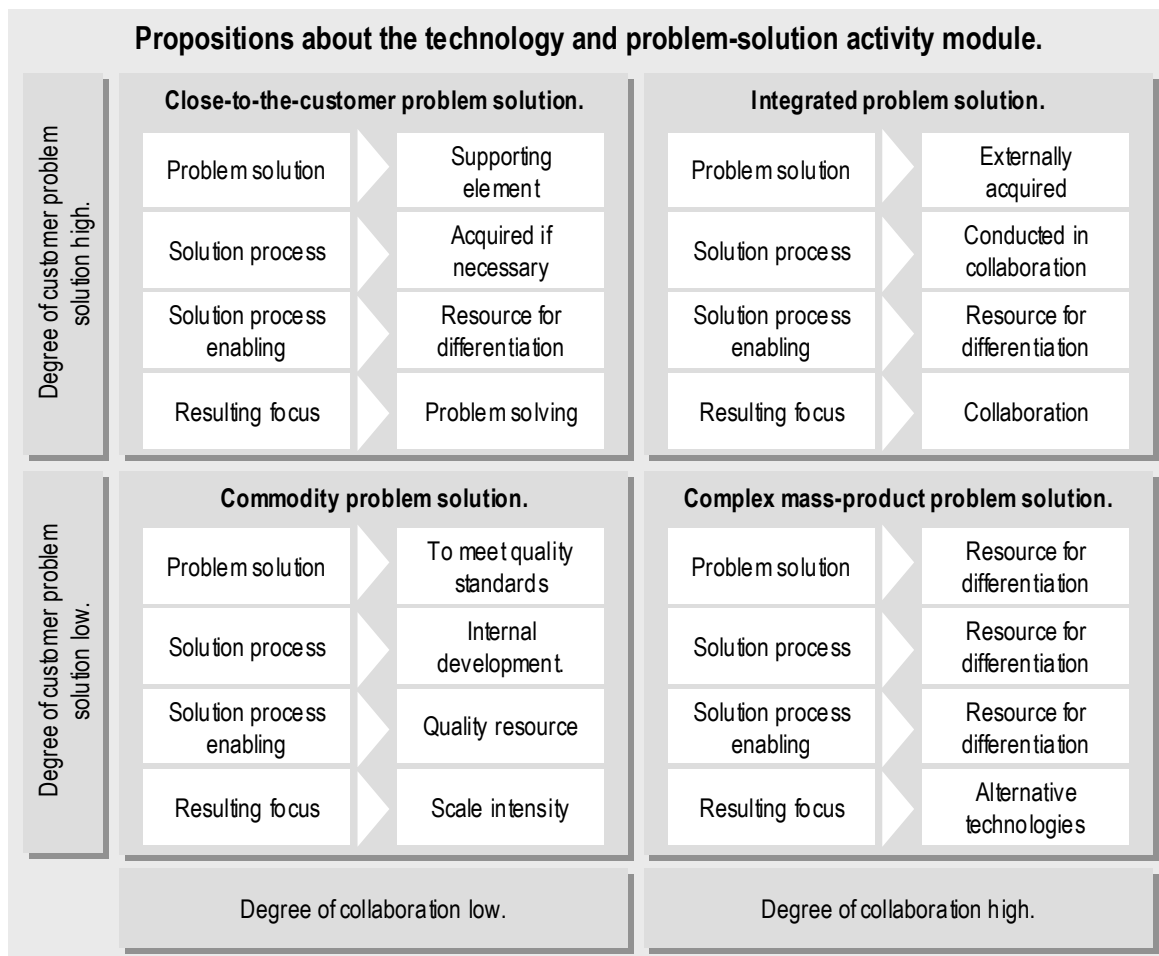


Figure 22: Propositions about the technology and problem-solution activity module, developed by the author.

### **The competition and co-operation activity module.**

In market places, organisations offer problem-solutions for potential customers who have restricted budgets. As Schumpeter (1912) showed, innovation can lead to monopolistic structures that are undermined by new market entrants. As a result, within a market there is direct competition. Porter (1982) identified four further types of competitive forces: bargaining power of suppliers and customers, new entrants, and substitutes. As transaction cost theory shows, suppliers and customer do not only have bargaining power, but they also might be interested in vertically integrating the problem-solution. As a result, substitute problem solvers, clients, suppliers and direct competitors compete for value creation and profit generation, and thus for a better fit to the customer's problem definition and restrictions. In order to generate this value, organisations do not only compete, but also have to collaborate (see section 5.1). Especially in innovation processes, collaboration is an important issue, which has been shown by von Hippel (1987), Teece (1986), Hamel et al (1989), Tether (2002), and other researchers. Considering that clients and suppliers are not only collaboration partners but also potential competitors, the reason for joint description of this activity module becomes clear. Teece (1986) distinguishes the three types of generic, dependent or co-dependent resources or assets, which have to be aligned in a supply chain for successful innovation. Further, taking a resource-based perspective to strategy, Grant (1991, 1991a) lists various types of resources that have the potential to generate competitive advantage. These can be intellectual property, brands, market share, firm size, financial resources, process technology, access to input resources, product technology, and market access. In addition, information has to be considered as an important resource in order to reduce uncertainty (see chapter four). By collaborating with other organisations, innovators can get access to these resources when they are necessary for successful innovation. To summarise, two types of collaboration partners can be identified: problem solving related and those providing access to resources. Resource providing collaboration partners need to be selected individually to a specific situation. However, the most important resource that should be available in a situation can be described.

Thus, in the competition and co-operation module, the major task is to identify, evaluate and understand potential competitors and collaboration partners, and to define requirements for collaboration with potential partners. As a result, to distinguish the four situations, the levels for competition and potential resources have to be understood in order to derive an activity focus.

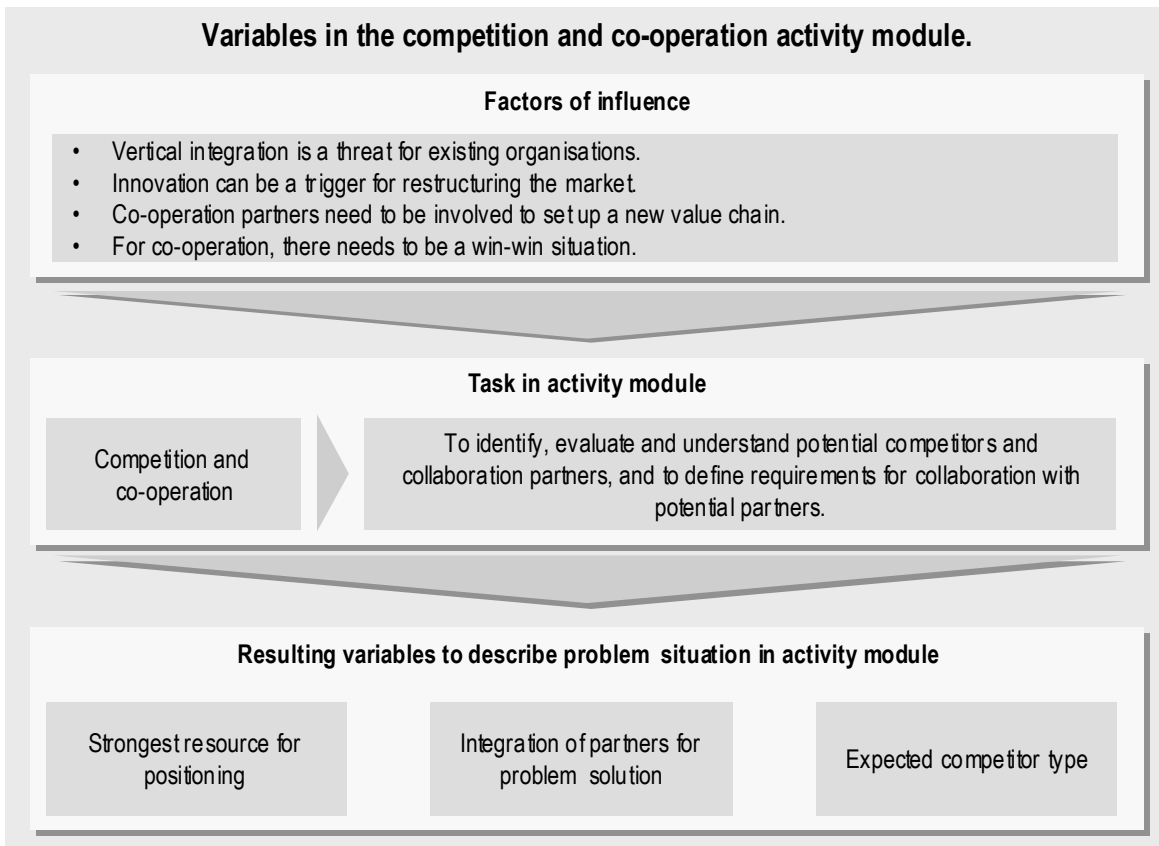


Figure 23: Variables in the competition and co-operation activity module, developed by the author.

**The competition and co-operation module in the close-to-the-customer situation.**

According to the propositions one, 1.1, 1.2, and the considerations above, the following proposition 1.3 can be derived.

In the close-to-the-customer situation, the customer needs are multidimensional, complex and highly specific, and thus problems are solved in a project oriented way. Due to the high specificity of customer needs, collaboration is limited to clearly defined subtasks. As a result, the most important resource in this situation is the knowledge about customer problems, customers' trust in problem solving capabilities, and finally customer contact and loyalty. Collaboration in this situation is proposed to be focused on acquisition of technology for the problem solving process. Competition in this situation is about individual relations to customers to solve their problems. Thus, customers and direct competitors are the most important competitors, while substitutes and suppliers play a less important role.

**The competition and co-operation module in the commodity situation.**

According to the propositions two, 2.1, 2.2, and the considerations above, the following proposition 2.3 can be derived.

In the commodity situation, customer needs are of low complexity, and the problem-solution is highly standardised. Due to the high standardisation, a large number of customers can be supplied with the commodity problem-solution. As a result, economies of scale and production technology competence are the most important resources in this situation. Collaboration in this situation is proposed to be focused on problem-solution. Competition in this situation is based on cost, quality and availability of solutions, thus the importance of direct competitors and customers is higher than the importance of suppliers. Additionally, due to the limited product complexity, the importance of substitutes is comparably higher.

**The competition and co-operation module in the mass-product situation.**

According to the propositions three, 3.1, 3.2, and the considerations above, the following proposition 3.3 can be derived.

In the mass-product situation, customer needs are multidimensional and the problem-solutions are also multidimensional, but standardised. Due to the standardised multidimensionality of problem-solutions, the solutions are applicable in various different contexts. As a result, the most important resources in this situation are in the combination of technical competence, market access, and the ability to co-ordinate the supply chain. Collaboration in this situation is not focused on a specific type. However, competition is multidimensional about customer relations and technical resources. As a result, competitors can be found in all of the four defined types.

**The competition and co-operation module in the integrator situation.**

According to the propositions four, 4.1, 4.2, and the considerations above, the following proposition 4.3 can be derived.

In the integrator situation, customer needs are multidimensional and individual, problem-solutions are multidimensional and partially standardised. Standardisation, complexity and individuality lead to a more intensive customer relation. Due to better scale economies, solutions of other suppliers are bundled to build the whole problem-solution. Thus, the most important resources in this situation are customer contacts, market access, knowledge about customer needs, and knowledge about the supplier market. Collaboration in this situation is focused on customer problem-solution. Competition, similar to the mass product situation is multidimensional. As suppliers already offer partial problem-solutions, they are more important competitors than in other situations.

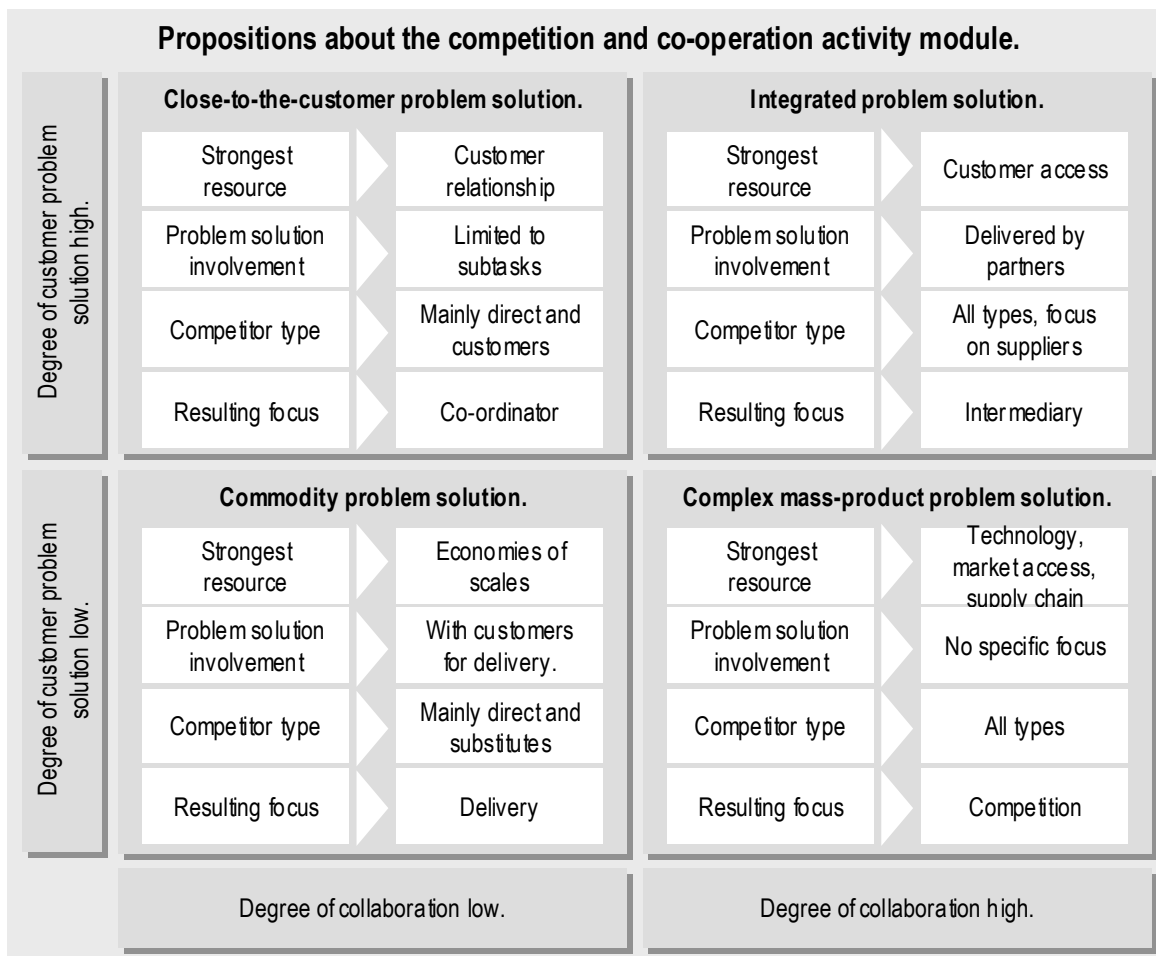


Figure 24: Propositions about the competition and co-operation activity module, developed by the author.

### The feasibility and organisational fit module.

In order to implement an innovation or an alternative problem-solution, the solution has to be feasible, and it has to be attractive to the innovator. These constraining factors can be determined by internal, individual factors, or by external factors. As already shown, business strategy determines a frame of action for innovation concept development. If a strategy in the sense of a plan exists, this strategy can be derived from planning considerations, or from a resource-based view. As a result, an innovation has to meet certain objectives that are both determined and constrained by the available resources. As shown in the previous section, these resources can be brands, market access, firm size, financial resources, technology expertise, access to external resources, or human resources to name but a few. Further, external restrictions also can constrain innovation success. Political, economic, societal and ecological factors can constrain the potential success of an innovation concept (Holt, 2002). Specifically, these factors are regulations, ethical, health and environmental factors, or availability of external resources. As a result, in this activity module the task is to evaluate the feasibility and attractiveness of an innovation concept and to clearly define the innovation problem prior to implementation.

The evaluation of constraining factors does not directly generate an innovation concept, it is rather an evaluation process. It is not clear whether generation and evaluation of innovation concepts can be strictly separated. Normally a project is stopped if it turns out to be unfeasible or unattractive



(Cooper, 1993; Khurana/Rosenthal, 1997). The definition of objectives, resource constraints, and the collection of results from each of the other activity modules has to be pursued by an organisation. Thus, the feasibility and organisational fit module was installed as an analytical measure in order to provide a connection to the organisational and strategic level of innovation problem solving. As this module is used as an analytical measure of getting access to organisations, and for the reason that feasibility and organisational fit are individual to an innovation project and to the respective organisations (see chapter two), here no further propositions for different situations will be developed. However, this module will provide a basis for the development of general propositions about method requirements in the next section.

**Summary.**

In this section, activity modules have been introduced in order to provide a frame for the description of variables to distinguish the tasks in different organisational situations. An activity module is a collection of tasks that have to be pursued in the pre-project phase. The following table summarises the tasks for each of the activity modules, the derived variables, and the propositions derived for each situation. In the next section, the concept of methods for problem solving in pre-project innovation processes will be operationalised in order to develop propositions for their selection in different situations.

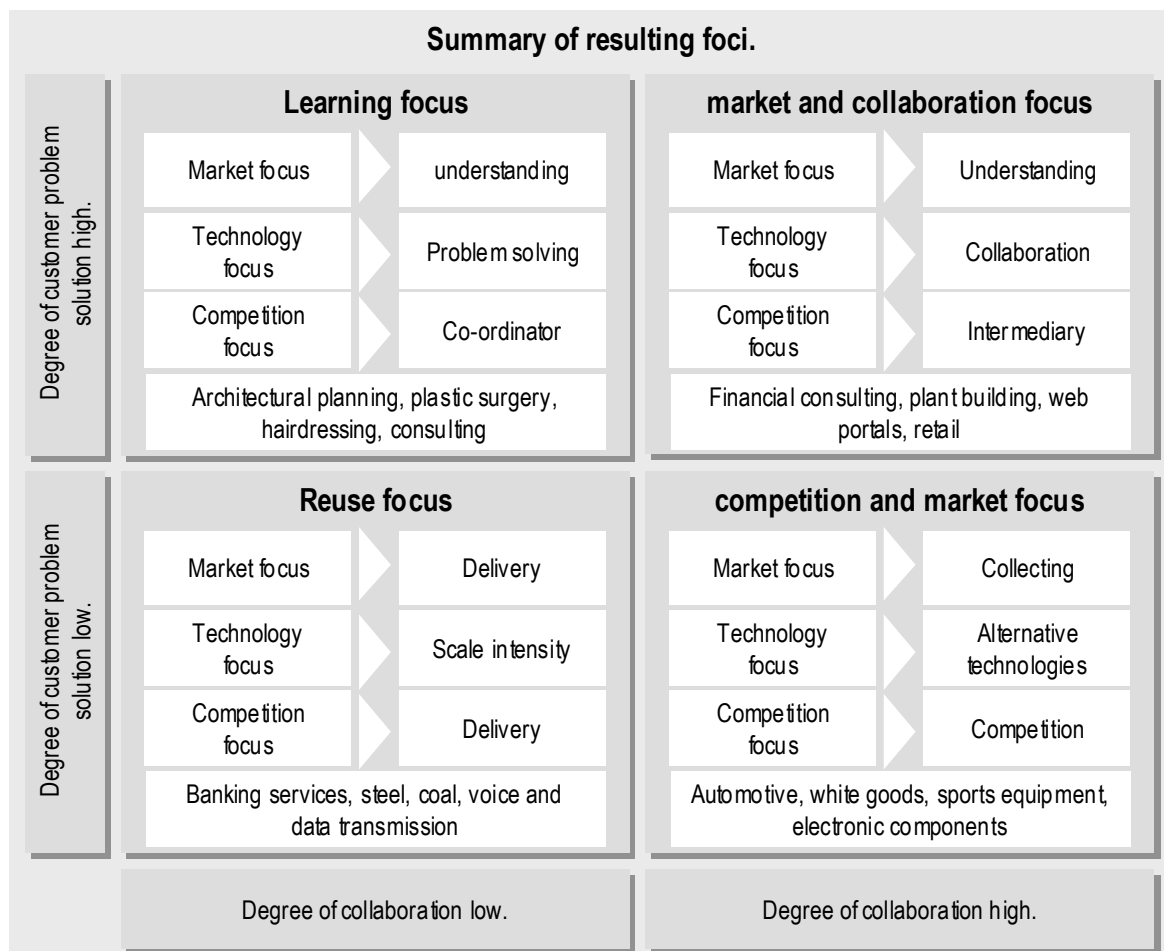


Figure 25: Summary of propositions about the different problem solving foci, developed by the author.

### **5.3 Methods in Innovation Pre-project Processes.**

In the previous sections, the frame for developing propositions about the requirements for the selection of methods in the pre-project phase was developed. First, the two dimensions of customer problem-solution and the degree of collaboration have been chosen to distinguish four generic situations as a frame of reference. Then, activity modules have been introduced to develop a frame for the selection and description of variables to elaborate propositions for different problem solving approaches in each situation. The aim for this section is to develop propositions for method requirements on the basis of the framework developed in the previous sections. In the first step, the role of methods, and the relevant dimensions for description will be derived. Then, on the basis of these dimensions, the variables for description will be elaborated. In the third step, propositions for method requirements, and thus the values of the respective variables will be developed on the basis of the theoretical framework.

#### **The role of methods in the pre-project phase.**

As introduced in section 4.2, problem solving processes require information for the generation and evaluation of alternatives. However, in most cases not all the necessary information is available to the decision makers, or it is not requested, or the information cannot be processed. The resulting lack of information is based on limited information processing capability, limited communication, or satisficing behaviour. As a result, methods can help to facilitate the problem solving and decision making process by providing a structure that helps to compensate these problems. Thus, methods help to identify, acquire, process and communicate information relevant to the decision process.

In this thesis, it is the overall objective to develop theory about requirements for methods in pre-project innovation processes dependent on different organisational situations. A method supports a problem solving process and thus is dependent on the problem itself. For this reason, the approach here is to analyse problems and problem solving approaches in order to derive the requirements. To date, methods have only been developed in concrete, specific problem situations or sub problems (e.g. von Hippel, 1989; Hauser, 1984; Kano, 1995). This research follows a completely different strategy. Instead of inductively collecting existing methods and deriving method requirements, here the innovation problem is the starting point for a deductive, theoretical approach. By proceeding this way, a broader range of problem fields can be identified, and existing gaps in method development can be illustrated. To conclude, in this thesis no concrete methods will be developed or evaluated, but only requirements will be elaborated and empirically validated. In consequence, on the basis of the dimensions of identification, acquisition, processing, and communication, variables for the description of methods will be introduced.<sup>23</sup>

As shown in chapter 4.2, the selection of methods depends on three levels of factors: the objective problem, personal preferences and capabilities, and organisational, cultural factors. In this thesis, only the problem itself shall be considered as a trigger for method selection. In section 4.3, it has been shown that organisational structure has a strong influence on communication methods and media. Further, the processing of information depends on the individual objectives of an organisation and its structure, as strategy and structure determine the criteria for evaluation of alternatives. As a result, the range of factors describing the objective problem of method selection on a general level is

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<sup>23</sup> However, a list of categorised methods was developed and used as stimuli in the case study research. The list can be found in appendix 2.

reduced to the identification and collection of relevant information that can then be processed and communicated within an individual organisation.

### **Variables for the description of methods.**

The aim of this section is to develop a set of variables that serve to describe methods for information identification and collection. Thus, the three factors of content, source, and quality of information become influential. These three factors will be explained below.

In the first step, the problem to solve or the decision to make have to be defined by setting objectives and determining alternatives. The problem itself thus defines the content of necessary information. The content of information is related to the overall innovation problem in the respective situation, but also to the second order problems defined by the activity modules. The collection of information does not only depend on the content of information. Analogous to research methodology (see chapter three), additionally the quality of information is essential, as only in the case of reliability, validity, and required generalisability, can the available information count as actual information defining an alternative. The development of models about the value of information would lead to a more qualitative approach, while the testing for generalisability would require a more quantitative approach. In addition, triangulation of research methods can help to create more valid models and better generalisability, by triangulation or sequence of method or information source. As a result, the quality of information will be described by the variables of research approach (qualitative vs. quantitative), and the mode of triangulation.

As introduced in section 4.2, the definition of shared objectives and the acquisition of information is a communication process and thus the interaction of communication partners has a strong influence on the quality of information. The interaction of communication partners can be roughly described by two activities: first, communication partners have to identify each other, and then they have to select a communication medium that suits the communication situation. The identification and selection of communication partners is determined by two factors: the affected objects that could deliver information about the problem, and further the geographical location of this object. As von Hippel (1994) describes in his concept of 'sticky information', some kinds of information are not available everywhere but only in a certain geographical place, like for example technology clusters.

At this point, the role of the second communication activity becomes important: The selection of appropriate media for communication. As shown in section 4.2, content of communication can be interpreted in different ways by different recipients, as communication has a content and a relationship aspect (Watzlawick et al, 1967). As shown, Daft and Lengel (1984; 1986) have developed the concept of media richness, which says that different media have different richness potential. Face-to-face communication for example allows much more complex conversation than e-mail or text messages can. Picot (1993) develops a model in which different communication problems lead to different requirements for communication between actors. He describes communication by its structuredness, and evaluates communication media by whether they can support the required structuredness or not. The communication media are described along the variables of time and space synchronicity, and form of transmission, oral or written. Four communication problems require different ways to communicate: The problem of accurateness affords more formalised, written communication as it bears the highest potential for structured communication, the problem of quickness bears less potential for structuredness, but more synchronous communication, the problem of confidentiality bears less structuredness potential, thus more synchronicity, and the problem of complexity does not bear potential for structuredness, and thus more face-to-face communication is required. In addition, a more structured communication problem can be addressed by a more prepared, standardised, formal act of communication. As a

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result, the selection of an appropriate medium can be described by the variables of synchronicity (high vs. low), richness of transmission form (high vs. low), and formalisation and standardisation (high vs. low). The following table summarises the variables that describe methods for information identification and collection.

<b>Variables for methods description.</b>		
qualitative	<b>Research approach.</b> What kind of information is required to solve the problem?	quantitative
Low	<b>Mode of triangulation, use of information sources.</b> How many information sources are required, and where are they located?	High
Low	<b>Synchronicity of communication, media richness.</b> Are there rich communication media required?	High
Low	<b>Formalisation and standardisation of information collection.</b> Is the communication structured and standardised?	High

**Table 7: Variables for the description of methods, developed by the author.**

## 5.4 Propositions for Method Selection in Different Strategic Situations.

In the previous sections, the variables for the description of methods in different situations have been developed. By referring to the propositions about problem situations, propositions for the selection of methods will be developed for each situation. In the first step, general propositions for second-level problems in each activity module will be developed to be followed by more concrete propositions for each of the situations. By proceeding this way, the differences between the situations can be elaborated more precisely.

### Proposition 0.1: General proposition about methods.

As shown in section 4.2, methods can be applied to provide a structure for the process of information identification and collection, and thus help to compensate satisficing behaviour. However, organisations are economic actors, and thus it is proposed that organisations apply methods in order to improve their decision making and problem solving processes under the constraint that they deliver appropriate information quality at minimised economic effort or maximised efficiency.

### 5.4.1 Propositions for the Customer Needs and Market Potential Module.

In this activity module, it is the central task to identify, understand, explicate, and predict customer needs and restrictions, to derive requirements for the problem-solution and to estimate the market potential. In order to derive propositions for different situations, in this module the variables described in table 7 will be set into relation with the variables of need dimensions, specificity of needs, and explicability of needs. In the customer needs module, information collection plays a crucial role for the definition of future problem-solutions. Depending on the number of potential customers and their need functions, different approaches to identifying and validating the findings will be necessary. Thus, the number of contexts for problem-solutions, the specificity of needs and the number of potential need dimensions become important factors for the identification of customer needs.

### Proposition 1.4: Customer needs in the close-to-the-customer situation.

In the close-to-the customer problem solving situation, the number of customer need dimensions is very high, and customer needs are highly specific. Due to the complexity of needs, their explicability is low. In order to understand, explicate and predict customer needs and restrictions, the information about customer needs has to represent this complexity. As a result, the approach to information collection is one of understanding and thus proposed to be rather qualitative than quantitative. Taking the general method proposition 0.1 into account, it is proposed that organisations seek to learn from their customer contacts within projects. In contrast, specifically dedicated customer meetings outside a concrete project are not proposed to be of high importance. The mode of triangulation thus is assumed to be related to the number of projects, in concrete the more often a specific customer need has been identified in different projects, the more likely the customer need is assumed to be valid. As projects are the main point of contact to the customer, the customers themselves appear to be the most important source for information about their needs. However, the evaluation of the industrial, technological, economic and legal environment of clients can indicate future needs. The primary source for customer needs is proposed to be the direct customer contact in project oriented problem solving processes. Thus, the information collection methods are

proposed to be of high richness and synchronicity (face to face communication), and of formalisation and standardisation adequate to the respective problem solving process.

**Proposition 2.4: Customer needs in the commodity situation.**

In the commodity problem solving situation, the number of customer need dimensions is low, and customer needs are of limited specificity. Due to the limited complexity of needs, their explicability is very high. In order to understand, explicate and predict customer needs and restrictions, the information collection about customer needs is proposed to aim for high explicitness. As a result, the approach for information collection is proposed to be more quantitative, highly standardised and formalised, and the mode of triangulation is of limited nature. Due to the high explicitness, the primary source for needs of existing customers are the customers themselves, and the required richness of communication media is limited, synchronous communication is also not required. Examples for the information collection approach are standardised questionnaires or ordering forms. Further, the evaluation of the needs of customers whose problems can potentially be solved by the available technology is proposed to be by secondary sources about their situation defined by their industrial, technological, political and regulatory environment.

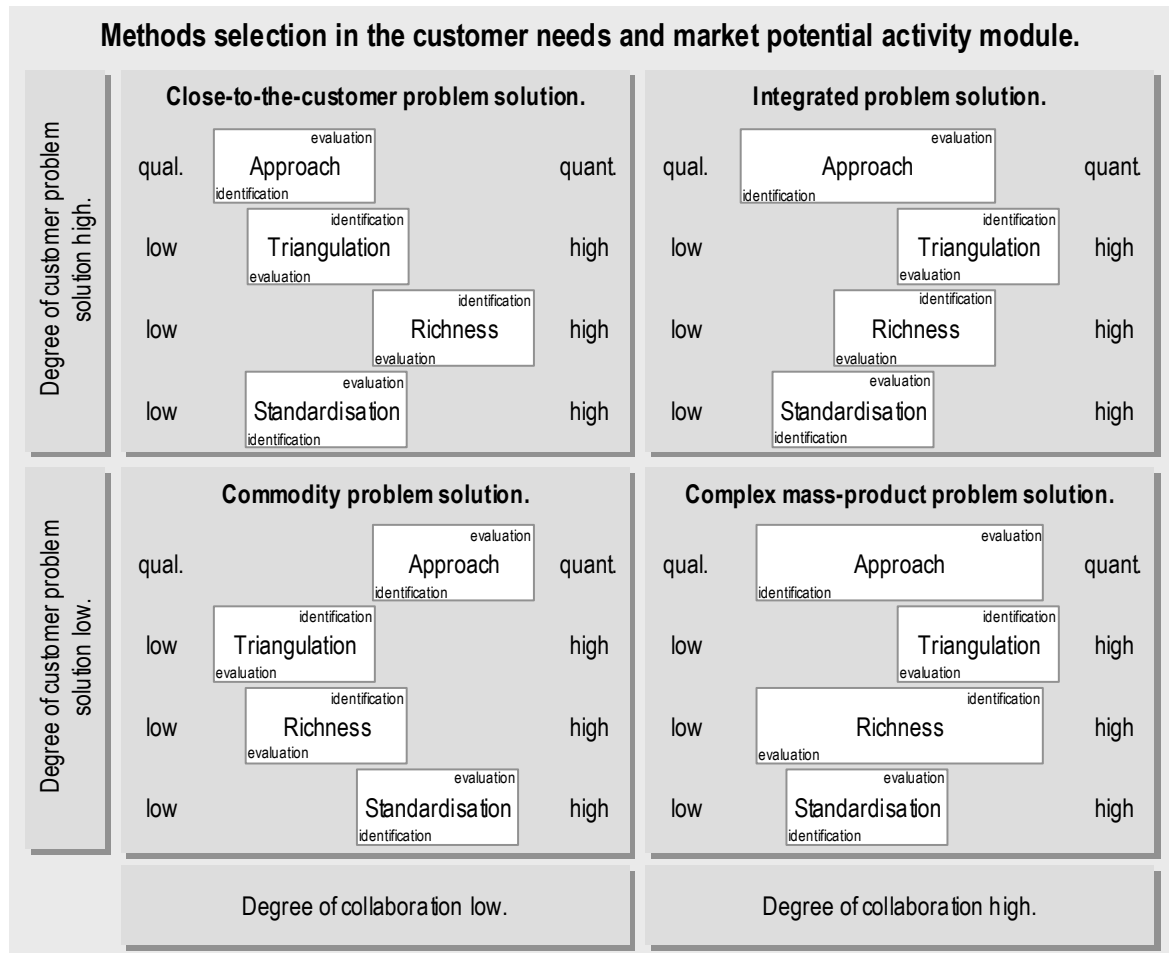
**Proposition 3.4: Customer needs in the mass product situation.**

In the complex mass-product problem solving situation, the number of customer need dimensions is high and specific to different contexts, and customer needs are relatively specific. Due to the complexity of needs, their explicability is low. In order to understand, explicate and predict customer needs and restrictions, the information about customer needs has to represent this complexity and the multiple contexts. As a result, the mode of collecting customer need information is proposed to be mixed and of multiple methods. On the one hand, the approach is proposed to be qualitative in order to understand customer need functions, and on the other hand the approach is proposed to be quantitative in order to assure representative generalisability. In consequence, the mode of triangulation will be one of multiple sources and multiple methods. While for the qualitative customer needs evaluation the primary source is proposed to be the customers themselves, for the quantitative part of the research secondary and primary sources can be appropriate. In the qualitative, understanding part of the needs evaluation, rich communication media with limited formalisation, and the geographical environment of the customers are proposed to be important. In contrast, the quantitative approach also allows media of limited richness, like standardised questionnaires or standardised phone interviews.

**Proposition 4.4: Customer needs in the integrator situation.**

In the integrator problem solving situation, the number of customer need dimensions is high and specific to different contexts, and customer needs are highly specific. Due to complexity and specificity of needs, their explicability is low. In order to understand, explicate and predict customer needs and restrictions, the information about customer needs has to represent this complexity and specificity. As a result, the customer needs evaluation approach is proposed to be a mix of qualitative and quantitative methods. In a first step, customer need functions have to be understood, which requires a qualitative approach. In the second step, validity has to be supported by a quantitative approach. In the third step, in the individual problem solving process, a qualitative evaluation method is required. Thus, the mode of triangulation is proposed to be of multiple methods and sources. The information sources in the first step are proposed to be a representative sample of customers, or secondary sources reused from mass product collaboration partners. In the second step, primary and secondary sources can be used in order to evaluate generalisability. In the third

step, the customers themselves are proposed to be the primary sources. In the first and second step, evaluation techniques can be standardised and partially asynchronous, while in the third step, more rich and only partially standardised information collection techniques are required.



**Figure 26: Propositions about methods selection in the customer needs and market potential activity module, developed by the author.**

#### 5.4.2 Propositions for the Technology and Problem-solution Module.

In this activity module, it is the central task to identify and evaluate technology alternatives that are suited to solve customer problems according to the defined requirements. In order to derive propositions for different situations, in this module the variables described in table 7 will be set into relation with the variables of role for problem-solution, role for solution process, and role for enabling the solution process. In the technology module, information collection plays a different role than in the customer needs module. To identify features and availability of technology is not the main challenge, as both these types of information are available. The challenge here is to understand and predict whether technologies will be suitable to meet customer need requirements and whether technologies will provide a sustainable competitive advantage. The role of new technology for the problem-solution, the problem solving process, or as an enabler of problem-solving thus is important for the selection of partnerships for technology development or acquisition. In general, technology acquisition takes four steps: identification, evaluation, acquisition, and implementation (see previous section). The identification and evaluation of technology depends on the role the acquiring

organisation plays. Either the organisation develops or customises a technology, or the organisation buys or applies a technology. In the first situation, an organisation has to work closely with the technology developers and to understand the dynamics of technology development. In the second case, the organisation has to select an appropriate supplier. For the selection of an appropriate supplier, alternative suppliers have to be identified, and changing costs have to be evaluated. In the development case, switching costs and thus investment risks are much higher. As a result, the topics of standardisation, technology protection and competing technologies gain much more importance (see previous section). On the basis of these reflections, propositions for the four basic situations will be developed.

**Proposition 1.5: Technology and problem-solution in the close-to-the-customer situation.**

In the close-to-the-customer problem solving situation, new technology is proposed to be a supporting element for the problem-solution. For the problem solving process, it is acquired if necessary, and its role as problem solving enabler is mixed, which means that it is either externally acquired or internally developed.

In this situation, new technology acts as a supporting element for the offered problem-solution. Thus, new technology is rather applied than developed, because it does not play the central role. In consequence, new technologies are searched for on the market and externally acquired. Thus, in the first step, only an overview about existing solutions is required, which can be obtained by secondary sources with communication media of comparably low richness. The research approach is more qualitative for the identification part, but more quantitative in terms of features comparison in the second step. Information sources will be suppliers of potential technology solutions, but also public sources in the case of for example open source software algorithms. As a result, here the process can be partially standardised.

Concerning the solution process, new technology can play a supporting role in the sense of file sharing or groupware systems for example. In the case that the solution process has to be supported by new technology, then it probably is externally acquired, and the same conclusions count as for the role of solution technology. Process enabling technology, like knowledge bases or best practice collections can be crucial to the problem solving process, or just to support value generation. In the first case, technology is likely to be adapted, while in the second case technology is likely to be purchased. In the case of adaption, a close relationship to the supplier is required and thus, rich, synchronous and less formalised communication is likely. In the second case, the same conclusions count as for the acquisition of problem-solution or process technology. In both cases, in the first step, the identification of potential suppliers is necessary, which can be conducted more qualitatively. In the step of technology and supplier evaluation, in the case of adaption a more qualitative approach is required, while in the case of purchase, a more quantitative approach is possible. In all cases, the mode of triangulation is supposed to be individual to the respective organisation. However, in the case of development, due to the higher adoption risk, a higher degree of triangulation is assumed. Due to the closer relationship in the development and adaption case, here more rich, synchronous and less standardised information media are expected compared to the external purchase case.

**Proposition 2.5: Technology and problem-solution in the commodity situation.**

In the commodity problem solving situation, new technology is proposed to be required to meet the defined quality standards, technology for the solution process (like production facilities) is developed in close co-operation with suppliers, and process enabling technology (like quality assuring elements) is also proposed to be developed in close co-operation with suppliers.



The product technology requirements are clearly defined by customer needs in this situation. As a result, the focus here is on the process of problem solving and process enabling technology, as these two define the product technology and quality. Due to the high strategic importance of these technologies, they are proposed to be internally developed, and process enabling technology is at least purchased and adapted. As a result, concerning these two technology types, a high degree of triangulation of sources, and more rich and synchronous communication channels are applied. In contrast, the evaluation of technology is supposed to be highly quantitative, structured, and formalised. As aforementioned, technology is evaluated by the defined customer needs.

**Proposition 3.5: Technology and problem-solution in the mass product situation.**

In the complex mass-product problem solving situation, new technology is proposed to be a resource for differentiation. As a result, depending on the strategic importance of technology, product, process, and process enabling technologies are constantly evaluated and compared with competitive technologies. Transaction cost theory proposes that more important technology is internally developed and less important technologies are externally acquired. As a result, in this situation propositions can only be made so far, as approaches are more qualitative in identification, but more quantitative in evaluation. Similar to the commodity situation, here also the quantitative customer needs information basis is proposed to serve as a basis for technology evaluation. In both steps, high triangulation of sources and methods is to be expected, and thus all richness, synchronicity and formalisation types of communication media are proposed to be found.

**Proposition 4.5: Technology and problem-solution in the integrator situation.**

In the integrator situation, new technology for the problem-solution is proposed to be externally acquired, the solution process technology is adapted, while process enabling technology is a resource for differentiation and thus internally developed.

The problem-solution technology is part of the integrated problem-solutions offered by the integrator. As a result, this technology is acquired from the market, which implies a more qualitative approach to identification, but standardised and quantitative approaches to evaluation. As the integrated technologies are strategically important resources, triangulation of sources and methods is supposed to be high. The most important technology type is the process enabling technology, as this is the key to integration of other products. For retailers, this might be technology or principles of how to offer the sold products, whereas for an insurance or financial consultancy, this may be the way of managing the different sources of financial problem-solutions. Here, strategic importance is very high, so that it is assumed that organisations in this situation are the co-ordinators of the internal development process. This implies high triangulation of methods and sources, and rich and synchronous communication, even in the evaluation phase. Process technology has an impact on the quality of the problem-solutions. As a result, no general propositions about this technology type can be made.

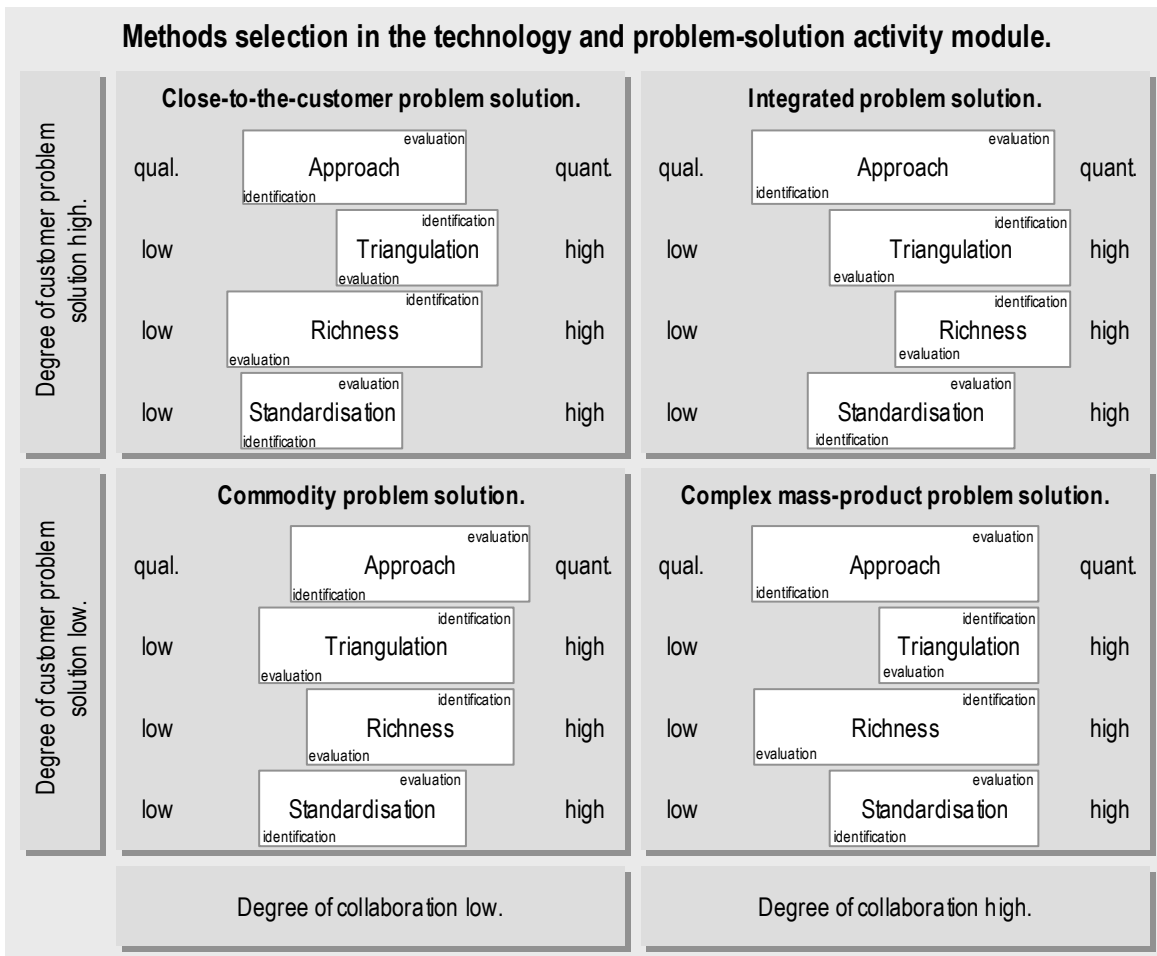


Figure 27: Propositions about methods selection in the technology and problem-solution activity module, developed by the author.

### 5.4.3 Propositions for the Co-operation and Competition Module.

In this activity module, it is the central task to identify, evaluate and understand potential competitors and collaboration partners, and to define requirements for collaboration with potential partners. In order to derive propositions for different situations, in this module the variables described in table 7 will be set into relation with the variables of strongest resource, role for problem-solution, and competitor type. In the co-operation and competition module, the identification and evaluation of potential partners or opponents is the central aspect. Different levels of competition and different modes of collaboration lead to different approaches to identify other players. As resources are important and predominantly unique factors, organisations will tend to use them in order to generate competitive advantage and to find collaboration partners to generate win/win situations. Further, different types of competitors arising in different constellations lead to different searching fields and foci for innovations or new competitive measures. As a result, organisations play different roles in partnerships and other external relationships, and as a consequence of these different roles, the approach to defend a position and for the identification of fields for differentiation differ. On the basis of these reflections, propositions for the four basic situations will be developed.

**Proposition 1.6: The co-operation and competition module in the close-to-the-customer situation.**

In this situation probably the strongest resource is the contact and knowledge about customer needs. In order to contribute to co-operations, this resource has to be used, and thus partners are proposed to be integrated in subtasks co-ordinated by the organisation. As a result, organisations in this situation seek for partners who contribute to improve customer problem solving. Due to the high specificity and complexity of customer needs, partners for collaboration cannot be identified and evaluated in a highly standardised way. Thus, it is proposed that the approach for identification and evaluation of collaboration partners is more qualitative and triangulation by sources is high. As competition is to be expected by direct competitors and customers, and due to the high specificity and complexity of needs, identification and evaluation of competitors is also more qualitative and does not play a major role. This is due to the lack of comparability of problem-solutions.

**Proposition 2.6: The co-operation and competition module in the commodity situation.**

In this situation, economies of scale are the most important resource for competition, and collaboration is focused on delivering ordered problem-solutions. As a result, the criteria for identification and evaluation of partners can be quantified and highly structured. Triangulation does not play a major role here. Concerning competition, predominantly direct and substituting competitors are expected. The identification is due to the different nature of substitutes and is unlikely to be completely quantitative, however a highly structured, formalised and asynchronous approach is expected. In order to identify new substitutes, higher triangulation of sources will be required, although due to the well defined customer needs, a highly structured evaluation process is possible.

**Proposition 3.6: The co-operation and competition module in the mass product situation.**

In this situation, the strongest resources are technology and market access which are used as contributions to collaboration. Collaboration here focuses on suppliers who can produce problem-solutions more efficiently or who have the necessary technological competence. The definition of inputs has to be done in close co-operation, because criteria have to be defined together to fit into the co-ordinated supply chain. As a result, the identification is conducted qualitatively in the first step, but well-defined inputs lead to quantified evaluation criteria. The collaboration is based on a mix of rich, less standardised communication, and formal, more standardised media. Competitors are to be found of all available types, and as customer needs are multi dimensional and multi contextual, identification and evaluation of competition is not trivial. Only direct competitors can be identified and evaluated in a standardised way, as they probably use similar distribution channels. In order to identify and evaluate other competitors, a mode of high triangulation, less structuredness and more rich communication is expected. However, due to the complexity of customer needs, a simplification of information will probably be necessary and thus criteria for evaluation are also expected to be more quantitative than qualitative.

**Proposition 4.6: The co-operation and competition module in the integrator situation.**

Integrators bundle problem-solutions of other suppliers in order to satisfy their customers' needs. Thus, the most important partners for collaboration are suppliers, and the most important resource for collaboration is customer contact and market access. The definition of inputs is standardised and quantitative, as complete products are combined into one solution. The identification of partners is supposed to be conducted in a mode of high triangulation, but structured and quantitative. Competitors are to be found of all types, however suppliers play an important role as competitors.

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Thus, identification and evaluation are also supposed to be of a structured, quantitative nature. However, the comparison of competitive problem-solutions is a problem of validity because of the specificity and complexity of customer needs. The mode of competition thus has to be evaluated by a mix of qualitative and quantitative criteria in order to reduce complexity.

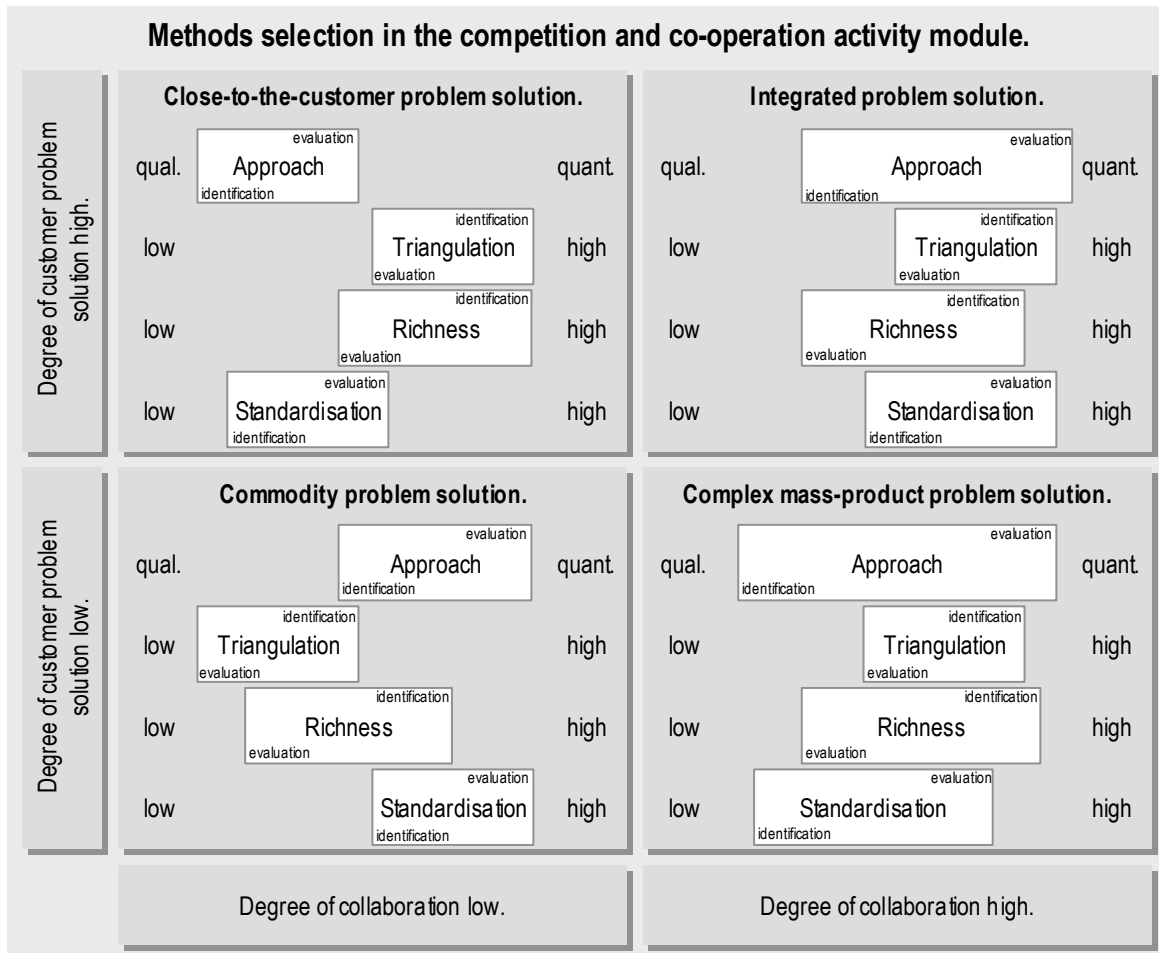


Figure 28: Propositions about methods selection in the competition and co-operation activity module, developed by the author.

## 5.5 Summary.

In this chapter, the basic propositions have been derived from theory. In the first step, the four situations of close-to-the-customer problem solving, commodity problem solving, complex mass-product problem solving, and integrator problem solving have been developed and propositions for different foci in each situation have been derived. A situation has to be seen as a snapshot of an organisational situation, based on the product or service that provides a solution to customers' problems. Thus, organisations can be in more than one situation at a time. Then, in order to describe the four situations and their respective problem solving approaches, activity modules have been introduced to provide a structure for the selection of variables. Activity modules have to be understood as bundles of activities that lead to an innovation concept, which are not conducted in a sequential order, but in parallel because of their high interdependency. On the basis of these dimensions of description, propositions for values of variables have been developed to describe the differences between the four situations. As a result, the close-to-the-customer situation can be labelled as learning, understanding and problem solving oriented, the commodity situation can be described as reuse, delivery and oriented towards economies of scale, the complex mass-product situation can be called competition and market, resource collecting, and oriented toward alternative technologies, and the integrator situation can be described as market and collaboration oriented, and focused on understanding and collaboration. On the basis of the detailed description of the problem solving approaches in the four situations, in the final step the concept of methods has been operationalised and related to the activity modules in each situation. Then, propositions for requirements for methods in the pre-project innovation phase have been developed for different organisational situations. The propositions have been described in the tables of each section.

The propositions have been developed with the highest possible accuracy and precision. However, it is not possible to make an unstructured, complex and ambiguous process more structured just by describing it with appropriate variables. As a result, comparing the four situations, the propositions are not of completely consistent structure. It is the objective to compare and illustrate different foci in the four situations. This does not imply that a focus in one situation might lead to the fact that other activities are not pursued in the same way as in one of the other situations. As a result, the propositions will be used to illustrate differences, but not to exclusively describe organisational situations.

At this point, theory has been derived on the basis of existing theory and has only been underpinned with practical illustration. Therefore in the next section, these propositions are going to be further evaluated empirically in order to gain further insight and to develop concrete hypotheses for the selection of appropriate methods in the pre-project innovation phase in different organisational situations.

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In order to reach this overall objective, sub-objectives 1 and 2 of this research are to develop and operationalise a theoretical framework, and to derive propositions. In this chapter, these objectives were met and thus, theory is developed.

## **6 Empirical Validation, Hypotheses, Theoretical and Practical Implications.**

*Chapter aims: In this chapter, I have three objectives: first, I aim to evaluate and validate the theoretical framework. Further, I will develop hypotheses about the validity of the framework and will apply the theory by developing requirements for the appropriate selection of methods in the pre-project innovation phase in different organisational situations. In a final step, I will discuss theoretical and practical implications of the developed results.*

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In order to reach this overall objective, objective 3 of this research is to validate the theoretical framework by case study research, to derive hypotheses about the framework and to develop requirements for method selection in different organisational situations. To meet this objective is the aim for this chapter.

The objective of this thesis is to develop, evaluate and apply theory about the selection of methods in the pre-project innovation phase depending on different organisational situations. In the first two steps, the conceptual level of innovation management was introduced and the concepts of decision making and the contingency view were described in the context of innovation concept development. In the third step, the theoretical framework for the description and analysis of relevant variables and their possible values was introduced and propositions for interdependences between variables were derived. In consequence, in this chapter the theoretical framework will be validated by empirical findings in order to develop concrete hypotheses about the framework and thus about the appropriateness of methods in different organisational situations. In consequence, the basic research question is whether the four situations exist, whether the activity modules are comprehensive and describe the actual problem in each situation, and whether the proposed method approaches are appropriate. In the first step, the objectives for this chapter will be described more precisely. Then, in order to provide a basis for the further discussion, methodological considerations will help to derive an appropriate proceeding that will lead to the described objectives. In the second step, the data collection process, results from data collection and a discussion of their methodological value will illustrate the research findings. In the third step, the discussion of findings and the theoretical framework will lead to the final hypotheses about the theory, which enables the derivation of requirements for methods selection in a final step. This represents the key results of this research work: The basis of a theory about the appropriate selection of methods in the pre-project innovation phase in different organisational situations, which has been evaluated and applied.

## 6.1 Research Objectives and Methodology.

As discussed in chapter three, theory provides explanatory and structured knowledge about a broad range of research objects on an abstract level, as theory serves to organise and communicate knowledge among researchers. In order to develop theory, research objectives have to be clearly defined, and key constructs and variables have to be clarified and described. Further, relationships between constructs and variables have to be described and explained. The objective of this thesis is to understand, to describe and to develop requirements for the appropriate selection of methods in pre-project innovation phases depending on an organisational situation. The concepts of organisational situations, innovation problem solving focus, activity modules, and methods have led to propositions about their application in different situations. Before requirements about appropriate method selection can be developed, the theoretical basis needs to be further refined. To summarise, the basic research question for this chapter is whether the four situations exist, whether the activity modules are comprehensive and describe the actual problem in each situation, and whether the proposed method approaches are appropriate. Thus, it is the objective of this chapter to develop hypotheses about the theoretical framework and to derive requirements for methods selection from the propositions presented in chapter five. In this section, the methodological proceeding for the empirical part of the research will be framed.

As seen in chapter three, hypotheses constitute the basis of theory, as they are the central means to clearly organise and communicate the knowledge developed in the theorising process. While variables and constructs describe the research phenomena, propositions and hypotheses take the explanatory role in theory. A proposition states the relation among constructs, while a hypothesis specifies this proposed relationship (Bacharach, 1989). Hypotheses alone do not make theory (Sutton/Staw, 1995). However, clearly derived and explained hypotheses constitute the key results of theorising processes and thus are the basis for further conclusions that can be drawn by applying the theory comprising the named hypotheses. The propositions developed in the previous chapter describe the concepts and variables and describe the relationship between them. A more precise and specific statement about the relationships between variables and constructs is a hypothesis, which bears the potential to be tested.

At this stage of the research, the variables and constructs are clearly described, and relationships between a situation and requirements for methods have been proposed. However, the propositions have not been validated by empirical findings, and thus the relationships between variables defined may be different from those resulting from empirical findings. As a result, it is the objective of this step of research to evaluate and validate the theoretical framework consisting of the concepts of organisational situations, innovation problem solving focus, activity modules, and the operationalised approach to method selection. The additional benefit of further developing the described propositions into hypotheses is comparably low, as hypotheses of this kind would not describe the quality of the whole framework. Instead, the framework will be evaluated and hypotheses will be derived about the quality of the framework. Then, the presented propositions will be further developed to derive requirements for the appropriate selection of methods.

The result will be a validated framework that allows conclusions to be drawn about requirements for methods and their implications. It is not the objective to further operationalise and test the developed hypotheses and theory, but rather to open up a new research field that allows the analysis of innovation problem solving from a new perspective. As a result, in this first step towards theory, it is more important to illustrate the potential and implications of this new research approach. This will be achieved by evaluating the theoretical framework, validating and further developing it by empirical findings, by the development of hypotheses, and by discussion of theoretical and practical implications for method selection in different organisational situations.

## Empirical Validation, Hypotheses, Theoretical and Practical Implications.

Because hypotheses constitute the key findings developed from theory, the same quality criteria count as for a theorising process (see chapter three). In order to deliver good theory, the research methods need to deliver objective, reliable, relevant, valid and verifiable data. The derived hypotheses need to be generalisable, significant, comprehensive, consistent, and precise. In the next step, a method will be developed to assure appropriate data collection.

### **The research design follows a case study approach.**

In this research, a theoretical framework has been developed from existing theory, because the basis of existing theory was considered sufficiently strong to derive robust conclusions (see section 5.1). Further, the research objects, that is the relationships between organisational situations, innovation problem solving focus, and innovation concept generation methods were not observable enough to develop a theoretical framework from empirical findings. As an additional factor, the theoretical fundament of this research is not far enough developed to be quantitatively tested or analysed. In consequence, qualitative techniques appear more appropriate. Here, the existing theoretical framework shall be illustrated, evaluated, and validated. As a result, a case study approach based on the theoretical framework will be chosen for the generation of empirical insights. The case study approach allows rich, insightful data to be generated, but also structured and generalisable results (Yin, 2003). According to Yin (2003), in order to design a case study approach, the following issues have to be covered: the overall case study design, the data collection design, the data collection itself, and the data analysis methods. In the following, these four issues will be further addressed in order to describe the research method applied.

### **The case study design comprises three cases per situation.**

The case study design needs to cover the five components of research questions, research propositions, units of analysis, the logic linking of data and propositions, and the criteria for data interpretation. The overall research objective of this thesis is to develop requirements for the selection of methods in the pre-project innovation phase in different organisational situations. These requirements will be derived from theory that still has to be developed. The theoretical framework, that is the concept of situations, innovation problem solving focus, activity modules, and methods now has to be verified, illustrated and evaluated. As a result, this is also the research question for the case study design. The research propositions have been developed and summarised in the previous chapter (figures 26, 27, 28). In consequence, the unit of analysis is a pre-project situation, which implies that two criteria define the unit of analysis: first, there needs to be a new customer solution that can be described as belonging to one of the defined situations, and further a pre-project phase must be defined. However, for the selection of case projects, it is of no matter whether the pre-project phase is finished or not. The theoretical framework proposes that it is the innovation problem in different situations which defines the method requirements, and thus these problems are the central objects for investigation. A situation refers to a concrete type of customer problem-solution and its collaboration type. The pre-project problem is directly defined by the resulting problem-solution. As a result, it is not relevant, whether the pre-project phase is at the beginning, at the end, or already completed, because the problem is not defined by the project phase but by external factors. The case studies will be selected from pre-project phases in order to research them in the appropriate context, but these may be at any stage of completion.

The theoretical framework does not specify any contingencies other than the second order problem of innovation problem solving on the conceptual level, and it distinguishes four different ideal-type situations. In order to evaluate the differences, a multiple case design is the appropriate choice (Yin, 2003). The cases have to be selected according to the four situations. Further, in order to provide a certain generalisability, the cases will be chosen from different industrial contexts, which solve similar



customer problem types, and in which organisations collaborate in the ways defined in section 5.1. It is not the objective to test the developed theory, but to evaluate and illustrate and thus validate it. Thus, three cases per situation is considered as satisfactory to compare innovation problems in different situations.

In the selected cases, the problem situation will be analysed along the variables that define the situation (customer problem solving degree, degree of collaboration), the activity modules (proceeding, fit and feasibility; market and customer needs; technology and problem-solution; collaboration and competition), and the applied methods in each situation (approach, degree of triangulation, richness of communication media). The case study data will be used to understand whether the resulting innovation problem solving focus can be interpreted as proposed, and whether the organisations in the case studies apply the proposed methods. However, it may be the case that organisations apply inappropriate or no explicit methods, which may lead to misleading conclusions. Thus, this second level of applied methods will only be used to verify whether the problem has been understood correctly by the researcher, in order to lead to further discussion points about the problem itself. In addition, the cases will be selected from organisations that have been identified as method sensitive, so that appropriate understanding and method application can be assumed as a basis for discussion. This is also important in order to distinguish organisational and personal factors from problem induced factors that influence method choice. To summarise, the basic research question is whether the four situations exist, whether the activity modules are comprehensive and describe the actual problem in each situation, and whether the proposed method approaches are appropriate.

**Interviews, archival records and other documental sources are used to define the data collection design and data collection.**

As described, a multiple case design is regarded as appropriate in order to evaluate, validate, and illustrate the developed theoretical framework. The data collection design has a crucial impact on the data results, and thus influences the quality of the conclusions to be drawn (Hussey/Hussey, 1997). As case study research is a non-routine approach, it has to be assured that the data collection design allows a structured, reliable, valid, and generalisable set of data (Yin, 2003). In order to design the data collection, the following issues will be addressed: case and sample definition, number of cases and organisations in which cases can be analysed, type of organisations, definition of cases within the organisations, definition and selection of sources to access the case study data.

As mentioned in the previous section, a sample of three cases per situation will be selected from different industries in order to avoid a focus on one certain industry, but to enable the understanding of the problem solving focus defined by a situation. Further, the organisations to be selected for analysis will be selected from a very similar cultural background. As shown in section 4.3, method selection is influenced by personal, organisational, cultural and problem related factors. Personal and organisational factors can be filtered out of the analysis, because they can be made explicit in data collection. Cultural factors however affect the whole system and thus are mostly implicit (Sutton/Staw, 1995; Chia, 2002). As a result, in order to reduce cultural factors to a minimum, a similar cultural, geographical, and similar organisational subunits background will be chosen as a basis for innovation problem and method evaluation. In this research, the organisations were all of German and Swiss nationality, and all organisations have been actively involved in method related research activities, like funded projects about innovation methods, or industry best practice communities.

In order to collect case study data, different sources are necessary to assure internal and external validity. Yin (2003) suggests six types of sources of evidence: documentations, archival records, interviews, direct observations, participant-observations, and physical artefacts. In order to collect

### Empirical Validation, Hypotheses, Theoretical and Practical Implications.

data about innovation problems, problem solving focus, and methods, only interviews, documentations and archival records can be regarded as relevant. Observations are not appropriate, because of the potentially long duration of pre-projects, and physical artefacts in this case are not seen as bearing relevant information. When the selected organisations were approached, the problem of confidentiality arose because of the high strategic importance of innovation pre-project processes. Consequently, in most of the organisations, only interviews were possible, and access to documentation was highly restricted. Further, it had to be agreed that the case studies would be anonymous. As a result, the most important sources for evidence were interviews and publicly available information. In order to triangulate pre-project problem impressions, it was planned to conduct a number of interviews with process participants. In the process of interview and case study acquisition, it turned out that in nearly every organisation, only one single individual had knowledge about one single pre-project. This is because only one person tends to co-ordinate a pre-project. Other process participants only contribute with sub tasks.<sup>24</sup> As a result, there was one interview conducted per pre-project, and the further evidence was collected by other, archival and documentary sources.

It was the objective of this section to frame the methodological proceeding of the empirical part of this research in order to meet the quality criteria for good theory. A case study research design was chosen as an appropriate approach. In the next section, the process of case study data collection and coding will be reflected, in order to discuss how the defined quality criteria have been addressed by the applied method.

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<sup>24</sup> This problem was also recognised by Hauschildt/Kirchmann (2001). In their study about early-stage innovation projects, they also had to focus on single interviews per project, because the concerned project teams are small and therefore only one person per project was available or sufficient.

## 6.2 Summary of Case Studies.

The aim of this case study research is to illustrate, evaluate, and validate the theoretical framework and the developed propositions. On this basis, hypotheses and requirements are going to be derived for the appropriate selection of methods in pre-project innovation phases in different organisational situations. In this section, the process of data collection and coding will be described and the cases are presented as summaries, in order to build a basis for the subsequent analysis of the theoretical framework. In the last step, it will be discussed, how the applied research method addresses the quality criteria for good theory. The results will serve as a basis for discussion and hypotheses development in the subsequent section. In the course of this study, twelve cases were analysed. The following figure illustrates, how each case fits into the framework.

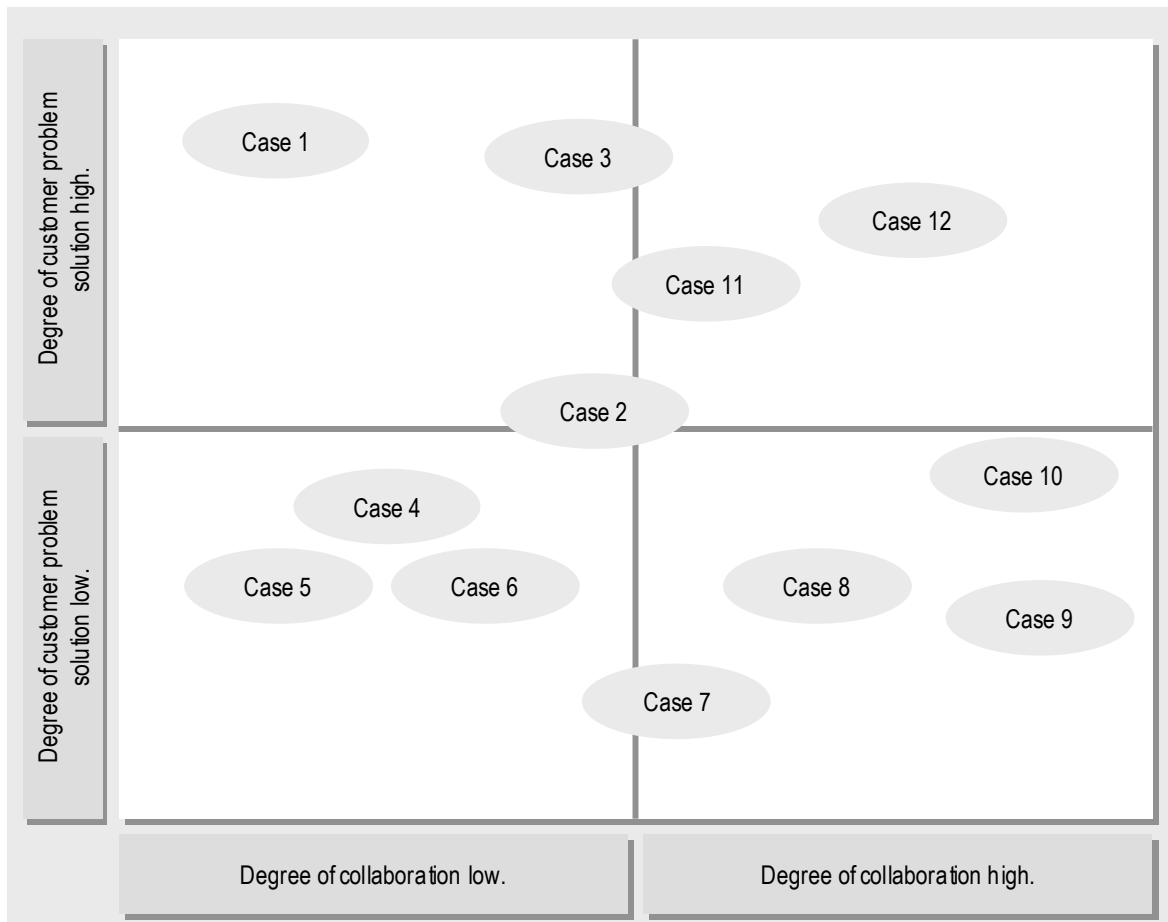


Figure 29: Overview of the conducted case studies.

The case study interviews were conducted as semi-structured interviews. In the first step, the organisations were approached in order to identify the most appropriate interviewee. These interviewees were introduced to the concept of organisational situations, and were asked to locate a typical pre-project of their choice in one of the situations. This location was compared with external information about the products offered by the organisation, their degree of problem-solution and the type of collaboration. In a second step the concept of activity modules has been introduced (these had been validated by four experts previously and considered by them to be valid and

comprehensive). The interviewee was asked whether the activity modules represent the process, and if there were any issues missing. In the third step, the interviewees were asked to describe the problems and methodological proceeding in their pre-project work. The interviews were recorded, transcribed and coded for cross-case comparison. The coding process was guided by the variables developed in the theoretical framework. In order to support the interview procedure, the interviewees were confronted with a set of pre-tested stimuli, that were developed from the relevant literature. The pre-test was conducted in conjunction with the pre-test of activity modules and organisational situations. The stimuli consisted of one list of activity modules, with task descriptions and examples for issues to be addressed in each module, one list of potential information sources, one list of potential methods for information processing, and one list with information and communication media and techniques. These stimuli were offered in order to help the interviewees to come to statements about their applied methods. In order to avoid any negative, misleading influence induced by the stimuli, they were only offered at the point when interviewees stated that they cannot state any further issues. Then, the stimuli were offered to possibly find further methods that were applied in the respective cases. The interview guideline and stimuli can be found in appendix 2. All case studies were anonymised, which was requested by the participating organisations. The research aims to analyse the conceptual level of early-stage innovation phases, and thus it is closely related to the future products of an organisation. The presentation of the case studies will be closely aligned with the theoretical framework, in order to enable precise evaluation and to identify supporting and contradictory outcomes.

#### **The interview data was coded on the basis of cross-case comparison.**

In order to analyse the case study data and in a subsequent step the theoretical framework, the case studies need to be described. As introduced above, the interviews were transcribed and the collected information was coded on the basis of the variables developed in the theoretical framework. To describe the complete coding process would be too voluminous for this thesis, and thus only an example will be given of how the case study data was interpreted to come to the resulting findings. In consequence, in this section the interpretation of case study data will be explained along the variable of “complexity of customer needs”.

In order to compare the occurrence of a variable in a case study, the value of the variable in the respective case needs to be described. Quantitative data can be described in nominal, ordinal or scalar order (Johnson/Harris, 2002; Hussey/Hussey, 1997). Differences between different nominal (or categorical) variables data can be described, but not be interpreted (“green” vs. “yellow”, “male” vs. “female”). Ordinal data can be ranked, but the differences or distance between the values cannot be interpreted (like grades “A”, “B”, etc., or “1<sup>st</sup>”, “2<sup>nd</sup>”, “3<sup>rd</sup>”). Scalar data can be of an interval type (where the distance between the values is the same, but mathematical operations with the variables are not valid, like temperature degrees, where “10” degrees is not half as warm as “20” degrees), or of a ratio type (where doubling an amount of a value means a doubled result (like metres, numbers of persons, etc.)). The described scale types are predominantly distinguished for data analysis in quantitative research. However, to compare data collected in qualitative case study research, it has to be clear as well, which type of data can be interpreted and thus, how the interview data should be coded. The variable of “complexity of customer needs” was explained in chapter five. The complexity of customer needs depends on the number of customer need dimensions and on the factors of influence and their interdependence on each other. The values of this variable can appear on a range between “low” and “high”. This implies, that the generated data is more than nominal or categorical. The construct of “complexity of customer needs” is complex itself, and thus a much more detailed operationalisation of the variable would be necessary to lead to valid, scalar data, where clearly observable values can be described or measured in a quantitative way.<sup>25</sup> In consequence,

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<sup>25</sup> This can be pursued at a later stage of research, when the framework will be evaluated in a quantitative way.

the variable of “complexity of customer needs” can be described by an ordinal scale. Because no objective, absolute values of the degree of “high” or “low” can be described, a cross-case comparison of this variable is necessary to provide a ranking of the impact of customer needs complexity on the construct of innovation focus in the concerning situation. Thus, the appearance of the variable in a case is first compared to the cases in the same or similar situation, and then compared to cases in other situations. A clear and consistent ranking of values of the variable is not directly possible. However, the context in which the variable occurs and the reasons why the value of the variable in a case is higher or lower than in another case allows to compare the results from case to case and thus provides analytical understanding of differences. In concrete, case one provides consultancy services to organisations in the field of CO<sub>2</sub> emissions trading, case 3 provides architectural planning, and case 5 supplies perforated sheets. In case 1, customer needs are described as highly complex, because organisational circumstances influence strongly interdependent customer needs. In case 3, this is very similar, and thus here is the same value as for case 1 (“high”). In contrast, customer needs in case 5 can be described predominantly by the three dimensions of “price”, “quality” and “speed of delivery”, which can be quantitatively measured. In comparison to other cases and groups of cases, this is the lowest value which can also be found in cases 4, 6 and 10 (“low”). This proceeding was conducted for all cases and all variables. One strength of case study research is that the context of a case is understood in order to generate analytical generalisability (Yin, 2003). Thus, the variables were compared to each other within the context of each case to cross-check consistency of data (in the case that highly complex customer needs would occur together with very low specificity of customer needs, this would have been surprising, and a further evaluation would have been necessary). By proceeding this way, qualitative case study research is enriched by quantitative elements in order to evaluate the theoretical framework.

As introduced in the beginning of this chapter, it is the objective of this part of the research to find out whether the four situations exist, whether the activity modules are comprehensive and describe the actual problem in each situation, and whether the proposed method approaches are appropriate. In consequence, the scales and values of each variable were not consistently predefined (like “very low”, “low”, “medium”, “high”, “very high”), because this would not have been possible to be consistently operationalised before the data had existed. One reason is, that the circumstances and interrelations of the appearance of each value was not known before, which is the result of this case study analysis. Thus, the applied operationalisation is the result of case study analysis and not the result of theoretical analysis. On the basis of this research, the framework can be consistently quantified, operationalised and tested at a later stage. Tables 8 to 11 summarise the case studies using the theoretical framework. More detailed descriptions of each case can be found in appendix 1.

		Case 1	Case 2	Case 3
Case description	Business model	Legal and business consulting for CO <sub>2</sub> emissions Trading.	Individualised search engine software and knowledge management solutions.	Architectural planning and project management
	Organisation type	Consultancy, 20 employees.	Software solution provider, 250 employees.	Architect's office, 3 partners.
	Data collection	Interview with Senior Project Manager.	Interview with Product Manager.	Group interview with Managing Partners.
Market potential/Customer needs	Needs complexity	High, due to organisational processes of clients.	High, due to organisational processes and different content of documents.	High, due to long product life-time.
	Needs specificity	Relatively high, due to dependence on legal environment.	Relatively high, due to requirements defined by users.	Relatively high, due to different application contexts.
	Potential explicitness	Medium, due to organisational processes of clients.	Medium, due to the varying number of users.	Low, due to long product life-time.
	Identification	Close collaboration in the course of projects, monitoring of legislation.	Close collaboration in the course of projects.	Close collaboration in the course of projects, standardised proceeding.
Technology/ Problem solution	Evaluation	Presentation to clients in the course of a project.	Presentation to clients in the course of a project.	Presentation to clients in the course of a project.
	Problem-solution technology	Knowledge about technology and legal issues.	Integrated in software.	Integrated in problem-solution, not provided by case 3.
	Problem-solution process technology	Self-developed, improving from project to project.	Standard applications for software development.	Specific standard solutions for planning and co-ordination.
	Problem-solution enabling tech.	Low importance.	Low importance.	Low importance.
	Identification	Oriented towards the market.	Oriented towards the market and competitors, in the course of projects.	Market screening.
Co-operation/ Competition	Evaluation	Mostly quantitative due to legal context of evaluation.	Presentation to clients in the course of a project.	Depending on specific solution (door handles vs. Insulation).
	Strongest Resource	Close client relationship, legal and business expertise.	Relationship to clients, technological expertise.	Close client relationship and ability to anticipate future needs
	Collaboration for problem-solution	Collaboration for defined subtasks, like technology evaluation.	Collaboration for specific, technical subtasks.	Collaboration with executing partners, under supervision.
	Competitors	Mainly direct and large potential clients.	Mainly direct, oligopolistic market structure.	Direct and large potential clients, only before contracting.
	Identification	In the course of running projects, unstandardised.	Informal, in an ongoing process.	Informal, contacts from prior projects.
Findings	Evaluation	Case specific.	Unstructured, in order to identify further customer needs.	Unstructured, in order to identify new way for problem-solving.
	Proceeding, fit and feasibility	Successive concept development, learning orientation.	Bottom-up strategy development, fit evaluated in the course of projects.	Technical feasibility evaluated parallel to needs evaluation, fit before contracting.
	Conclusions	Low importance of methods, individual problem-solving.	Successive improvement of semi-standardised product. Methods play minor role.	Methods used for complex communication and evaluation processes.

Table 8: Findings for cases 1-3.

		Case 4	Case 5	Case 6
Case description	Business model	Production of carbon nano fibre material.	Supply of perforated sheets for displays and functional applications .	Supply of punching and bending parts for automotive industry.
	Organisation type	Material supplier start-up, 4 employees.	Metal processing company, 200 employees.	Automotive supplier, 25 employees.
	Data collection	Interview with Managing Director and technology development scientist.	Interview with member of supervisory board and former technology manager.	Group interview with Managing Partners.
Market potential/ Customer needs	Needs complexity	Low: defined by quantitative dimensions.	Low: quality , price, availability.	Low: quality , price, availability.
	Needs specificity	Low, differ between groups of customers.	Low, individual to later application of sheets.	Medium, due to different application contexts.
	Potential explicitness	High, clear criteria for description of product features.	High, defined by quantitative measures.	High, to be specified by CAD data.
	Identification	Close collaboration with lead clients.	Use of satisfied and unsatisfied client requests.	Collaboration with clients, anticipation of technologies.
Technology/ Problem solution	Evaluation	Quantitative, market size only implicitly evaluated.	Quantitative measures, however not explicitly calculated.	Quantitative measures, not explicitly calculated.
	Problem-solution technology	Material, search for further applications in an ongoing process.	Represented by perforated sheets for further processing.	Represented by semi-finished parts.
	Problem-solution process technology	Self-developed, central means for problem-solution.	Defines limitations for price, quality and availability .	Defines limitations for price, quality and availability .
	Problem-solution enabling tech.	Low importance.	Low importance.	Low importance.
	Identification	Oriented towards market and scientific community.	Together with suppliers of production facilities.	Creative process of tool conception.
Co-operation/ Competition	Evaluation	Quantitative evaluation in laboratory.	Ex post, by quantitative measures.	Ex post, by quantitative measures.
	Strongest Resource	Production technology and knowledge about material.	Production facilities and brand name.	Production facilities and close customer relationship.
	Collaboration for problem-solution	Collaboration with lead clients for needs definition.	With suppliers for technology development.	With customers for product specification.
	Competitors	Mainly direct and large potential clients.	Direct and large clients.	Mainly direct and large potential clients.
	Identification	Unstructured, in the scientific and market community.	Informal, in an ongoing process.	Competitors are known, local distribution.
Findings	Evaluation	Predominantly to identify new product applications.	Predominantly to identify new product applications.	Predominantly to identify new product applications.
	Proceeding, fit and feasibility	Feasibility evaluated in parallel to need specification, fit defined by production technology.	Fit identified with unsatisfied client request, feasibility in collaboration project.	Technical feasibility evaluated parallel to needs evaluation, fit before contracting.
	Conclusions	Methods are applied implicitly and in quantitative evaluation processes.	Methods applied implicitly or cost and performance related.	Methods applied implicitly, or for new problems to solve.

Table 9: Findings for cases 4-6.

		Case 7	Case 8	Case 9
Case description	Business model	Supply of specialised glass components.	Supply of specialised software for security applications.	Supply of telecommunication end devices.
	Organisation type	Multinational supplier, 17.200 employees.	Supplier of software to identify incidents from video information, 25 employees.	Multinational supplier of end devices, several thousand employees.
	Data collection	Interview with Head of New Business Development.	Interview with Managing Director and Key Account Manager.	Interview with Vice President Business Innovation.
Market potential/Customer needs	Needs complexity	High, as customers depend on their own customers.	High, due to various product applications.	High, due to various product applications.
	Needs specificity	Medium, homogeneous for target groups.	Medium, homogeneous contexts for customer groups.	Relatively high, but homogeneous for groups of customers.
	Potential explicitness	Partially low, as needs depend on customers of customers.	Medium, due to dependence on security system for integration.	Low, due to several potential product applications.
	Identification	Focus groups, future products anticipation.	Observing influences on potentially vulnerable objects.	Market research, Think Tank, Integration in customer communities.
	Evaluation	Quantitative, market size only implicitly evaluated.	Together with potential clients.	Extensive multi-methods approach.
Technology/ Problem solution	Problem-solution technology	Represented by glass components.	High importance, as represented by the software.	High importance, represented by product.
	Problem-solution process technology	Defines limitations for quality, price and availability.	Standardised applications for software development.	Outsourcing potential.
	Problem-solution enabling tech.	Low importance.	Low importance.	Low importance.
	Identification	In laboratories and in close relationship to scientific community.	Relationship to the research community, market orientation.	Relationship to the research community, market orientation.
	Evaluation	Quantitative evaluation in laboratory.	Qualitative, related to market potential.	Quantitative evaluation in internal and collaboration projects.
Co-operation/ Competition	Strongest Resource	Technology know-how and production facilities, market access is a constraint.	Technology know-how.	Technology know-how and market access.
	Collaboration for problem-solution	Suppliers and clients in the supply chain.	Clients who integrate the software in their products.	Technology suppliers and co-suppliers.
	Competitors	Mainly direct and producers of substitutes.	Direct and substitute developers.	Direct, substitutes and co-suppliers.
	Identification	Pilot projects, oriented towards the market.	Oligopolistic market structure, meeting at trade fairs.	Oligopolistic market structure, collaboration offered by partners.
	Evaluation	Predominantly to identify importance and market access.	Predominantly to identify new product components.	Predominantly by pilot projects.
Findings	Proceeding, fit and feasibility	Technology driven, evaluated by market success and potential market access.	Fit is seen as provided as long as competitors can be overridden.	Clearly defined criteria for strategic fit, feasibility evaluated in pilot projects.
	Conclusions	Methods used to satisfy decision criteria in stage-gate process.	Methods applied implicitly, they evolve in a specific problem situation.	Explicit and extensive methods application.

Table 10: Findings for cases 7-9.



		Case 10	Case 11	Case 12
Case description	Business model	Supply of sensor applications to monitor cold chains.	Engineering of clean room facilities.	Supply of mobile TV.
	Organisation type	Supplier of product service combination, start-up 3 emp.	Supplier of engineering and consulting services, 8.200 employees.	Multinational mobile network operator.
	Data collection	Interview with Managing Director.	Manager in „Corporate Center“ Division	Interview with Senior Project Manager.
Market potential/ Customer needs	Needs complexity	Low, as customers depend on their own customers.	Very high, due to complex task.	Medium, due to various product applications.
	Needs specificity	Medium, homogeneous for target groups and different applications.	High, although relatively homogenous for certain industries.	Medium, homogeneous for groups of customers.
	Potential explicitness	Medium, homogenous for customer groups	Medium, although complex and strongly interdependent.	Low, due to customers' missing awareness of needs.
	Identification	Close collaboration with lead clients.	Close collaboration with clients, anticipating their customers' needs.	Market research, taking parallels from similar markets.
	Evaluation	Quantitative, market size only implicitly assumed.	By account managers, together with clients.	Implicit assumption of market size.
	Problem-solution technology	Represented by product.	Incorporated in delivered production facilities.	Represented by TV content.
	Problem-solution process technology	Important for service component.	Standardised applications for collaboration and co-ordination.	High importance of components integration.
Technology/ Problem solution	Problem-solution enabling tech.	Low importance.	Lower than expected.	High importance of technological standards.
	Identification	In close collaboration with suppliers, creative problem-solving.	Conducted by technicians, market oriented, research community.	Relationship to suppliers and co-suppliers.
	Evaluation	In collaboration with clients.	Pilot projects or in the course of client projects.	Evaluation in internal and collaboration pilot projects.
	Strongest Resource	Technology know-how, market access to be built up.	Customer relationship and know-how about facility engineering.	Market access and technological know-how for standards definition.
	Collaboration for problem-solution	Suppliers and clients in the supply chain.	Strong collaboration with suppliers.	Technology suppliers and co-suppliers.
Co-operation/ Competition	Competitors	Mainly direct and producers of substitutes.	Direct, but of limited importance. Subject to clients' procurement policy.	Direct and co-suppliers.
	Identification	Oriented towards the market and technology cluster network.	Oligopolistic market structure, market orientation.	Oligopolistic market structure, partners and competitors are known.
	Evaluation	Predominantly to identify new potential clients and product applications.	Quantitative evaluation of suppliers, to meet quality standards.	Predominantly in pilot projects.
	Proceeding, fit and feasibility	Technological feasibility evaluated in collaboration with lead clients, fit not relevant yet.	Opportunity recognition conducted by management, technical feasibility in projects.	Strategic fit defined by refined criteria, feasibility evaluated in pilot projects.
	Conclusions	Methods are applied intuitively, or in specific, new problem situations.	Methods applied implicitly, no standardised process.	Explicit methods application, to satisfy evaluation criteria.

Table 11: Findings for cases 10-12.

**Summary: How the quality criteria for theory have been addressed by the applied method.**

In chapter three, four criteria for good theory have been introduced. In this summary it will be illustrated how the applied methodology contributes to the criteria of objectivity and reliability; validity and verification; comprehensiveness, consistency and precision; and relevance and generalisability. As shown in chapter three, absolute objectivity is not possible, as the research is determined by personal factors of the researcher, the way of conducting interviews, and the interpretation and analysis of the collected data. In order to assure a high degree of objectivity and reliability, a standardised interview guideline and stimuli were developed from a strong theoretical framework that was pre-tested by experts from academia and practice. Each case study interview was recorded, transcribed and coded along the developed variables. The pre-tests and the solid theoretical framework were used to assure validity and verification. These two measures are also suggested by Yin (2003), who stresses the importance of theoretical grounding of case study research. Although access to organisations was limited, archival sources were used in order to reach a certain degree of triangulation in order to assure a high degree of validity. Comprehensiveness, consistency and precision were reached by selecting three cases from all four situations, and by analysing evidence along the consistently and precisely developed variables and propositions in chapter five. Further, a multi cross-case comparison approach assured a consistent process of data analysis with limited subjective bias. The case study approach is relevant to the theoretical framework, as it has been directly derived from the latter. In case study research, statistical generalisability is limited, because the criteria for inductive, quantitative methods are not given. However, as Yin (2003) states, case study research provides analytical generalisability. The concept of analytical generalisability implies that research results cannot be significantly generalised to the basic population from which the sample was selected, but that research results contribute to theoretical concepts. Thus, the replication logic is similar to the one of experiments: the circumstances from which the conclusions are drawn are described and analysed, and thus the resulting conclusions can be replicated. As a result, in case the theoretical framework turns out to be validated by case study evidence, the research results can be generalised to situations determined by the contingencies described by the framework. Thus, the generalisability highly depends on the specificity and precision of description of the respective variables and constructs. In order to assure analytical generalisability, the selection of cases from all four situations and the careful determination of each case's situation and the validation of the concept of activity modules play a major role. A thorough process of data collection and coding helps to prepare the basis for a process of highly valid data analysis. In this research, this is the evaluation of the theoretical framework.

The findings presented in the tables above are used to illustrate and analyse the theoretical framework for validity. In the next section, this analysis will be conducted and hypotheses about the framework will be developed. In the subsequent section, the framework will be applied in order to derive requirements for method selection in different organisational situations.

### **6.3 Discussion and Development of Hypotheses about the framework.**

In the previous section, the case studies have been presented and first case-related conclusions have been drawn. It is the objective of this section to discuss the findings with the initial propositions from chapter five and additional relevant literature. As a result, hypotheses will be developed about the quality of the theory in order to derive requirements for the appropriate selection of methods in different organisational situations. The requirements will not be developed exclusively from empirical findings, as the available data does not have the potential to serve as a basis for derivation. First, the available data is unlikely to be representative of the applied methods of all organisations of the basic population, and secondly it cannot be said whether the selected organisations represent best practices so that recommendations could be drawn. However, the collected case data can serve as a basis for analytical generalisation. This implies that the problem situations described serve as a source for empirical validation of the propositions. The insights about actual method selection will be used to serve as a basis for discussion about what role methods play in practice and to understand the discriminatory power of the variables that influence method appropriateness. In chapter four, organisational, personal and objective factors were identified, and further in chapter five, the organisational situation and innovation problem solving focus, activity modules and method description variables were described to distinguish method appropriateness. It is the objective of this section to validate and illustrate the discriminatory power of the selected variables. In the first step, the distinction between organisational situations and problem solving focus will be analysed. In the second step, the role of methods for innovation problem solving will be discussed, to be followed by a discussion of each activity module. In steps two and three, hypotheses will be developed for each situation to serve as a basis for requirements definition in the subsequent chapter.

#### **6.3.1 Analysis and Discussion of Situation Related Findings.**

The propositions developed in chapter five are based on ideal-type descriptions of innovation problem situations, which are defined by two dimensions: customer problem solving focus and the degree of collaboration necessary or dependence on external parties. It has already been discussed that ideal-type situations do not necessarily exclusively describe every possible type of organisation, but rather tendencies that count for organisations in each situation. The close-to-the-customer situation was described as project and learning oriented, the commodity situation was described as economies-of-scale oriented, the complex mass-product situation was described as market and competition oriented, and the integrator situation was described as collaboration and market oriented. In order to illustrate, evaluate and validate the theoretical framework, twelve organisations and customer problem-solutions have been selected as illustrative examples for organisational situations. The illustration and evaluation of the framework was conducted from two sides: First, the innovation problem was described, and in the second step the organisation's solution approach was analysed. As a result, the allocation of a case study to a situation followed a two-step approach: At first, on the basis of the theoretical framework, examples were constructed (see chapter five), then in the second step, organisations of this exemplary type were selected and analysed. After this analysis, the final decision about case classification was made.

Not each of the organisations selected as case study examples could be allocated to one exclusive situation. The theoretical framework developed in chapter five builds sets of variables that describe organisational situations derived from theory. When selecting organisations for validation and illustration of this framework, the question arises which of the two should serve as the object of evaluation and which is the measure: Is it the empirical data which shall provide a measure for evaluation of the theoretical framework, or shall it be the theoretical framework that serves as a basis

for evaluation of the empirical data? In the first case, the collected data which relies on observable variables might lead to completely different conclusions or propositions than developed in the framework and thus to less consistent findings, because the evaluated phenomena are not entirely accessible for direct observation (see also the related discussion in chapter five). On the other hand, in the second case, the data collection is guided by the theoretical framework, which leads to the risk that the framework might not be comprehensive enough, and thus that data collection leaves blind spots, because the framework might not be valid enough to describe the real world. At the beginning of chapter five, this issue was discussed and the conclusion was made that the theoretical basis is considered as strong enough for a theoretical derivation of a framework. As a result, at this point the question arises whether the collected data has the potential to illustrate the framework or not. In the previous section, an overview about the case studies was provided (tables 8-11). In the following paragraphs, the general findings from the four situations will be introduced, and also those cases that cannot be clearly allocated to one situation are discussed. As a conclusion, the discriminatory power of the framework will be discussed.

### **Findings related to the close-to-the-customer situation.**

In the close-to-the-customer situation, one ideal-type situation has been identified (case 1), one which is slightly oriented towards the integrator situation (case 3), and one that is slightly oriented toward a customised mass product (case 2), as shown in figure 29. What all the three organisations have in common, is that they all are project oriented, so they have standardised project procedures, but no standardised problem-solving processes. The ideal case (case 1) has no explicit innovation or new product development process, but learning routines to capture knowledge from previous projects in order to re-offer solutions in later projects. Further, in case 1, the organisation is also involved in creating the customer problem by participating in political activities. Thus, a certain focus on customer problems can be identified. All three cases have these learning routines, although the customised mass-product solution provider also has a product development process in which the core software product is improved, and software updates are also delivered to previous clients, and not only to current project partners. Case 3 is close to the integrator situation, because they exclusively offer conception, planning and co-ordination services to their clients. In the most exclusive definition, they should be categorised as integrators, because they do not provide the problem-solution themselves but co-ordinate the problem-solution process. However, each project is different from previous projects, so that the dominant variable here is the close relationship to the client which defines the situation. All three cases have a very close relationship to their clients in common, and all three cases show a project oriented organisation.

As a result, in close-to-the-customer situations, the clients and their problems are in the focus of all new solution development processes, and a learning orientation can be found.

### **Findings related to the commodity situation.**

In the commodity solution, two ideal-type organisations have been identified (case 5 and case 6), and one organisation that is not a commodity producer yet, but aiming to become one (case 4). In all three cases, the innovation processes were centred around the existing production technology, which means that organisations have tried to identify additional applications of their products (case 5), or additional applications of their production technology (case 6 and case 4). In all three cases, it was one of the most important objectives to maximise production efficiency for a defined product quality. Case 4 is still a young organisation, and the product and production processes are not completely established yet. The main difference between this case and the other two cases is that the relationship to lead clients is very close in order to define product quality, because at this point in time, no general standards about products exist.

As a result, innovation problem solving processes in commodity situations can be described as production technology and economies-of-scales oriented, which means that every new solution has to fit to existing facilities.

#### **Findings related to the complex mass-product situation.**

In the complex mass-product situation, one ideal-type organisation has been identified (case 9), one case which is closer to the commodity situation (case 7), and one case which is a younger organisation but on the way toward becoming a mass product producer (case 8). In all three cases, the importance of competitors was stronger than in all other situations. Probably the most remarkable finding for organisations in this situation is that there is no particular specificity to identify. Organisations in this situation have no specific general resource strengths and face hard competition. For this reason, market access, technology competence and all the other components important for innovation access have the same weighting. In case 7, which is closer to the commodity situation than the other two mass-product cases, it has been identified that economies of scale and production technology are more important factors than in the other two cases. However, product technology, market access and other competition related resources also play a very important role. In all three cases it was stressed that the focus for future innovation lies on what is demanded by the market, and what it is possible to realise. Competitors are an important source in order to find out about both demands and possibilities.

As a result, innovation problem solving processes in complex mass-product situations can be described as market and competition oriented.

#### **Findings related to the integrator situation.**

In the integrator situation, one ideal-type organisation has been identified (case 12), one organisation which is more oriented toward mass products (case 10), and one organisation which is more oriented toward the close-to-the-customer situation. The ideal-type organisation can be described as oriented toward the market and to the customer problem-solution. Because the organisation does not provide the solution itself, but only integrates solutions delivered by the market, the focus for innovation problem solving in this situation is on scanning the market for new options, and on maintaining the integrator position. The other two cases both integrate a small part of their own problem-solution with other solutions delivered by the market. However, case 11 is closer to the close-to-the-customer situation, because they are more project and learning oriented, and customer needs centred than the other two cases. On the other hand, case 10 is more oriented toward mass-products. Although they offer an integrated, but standardised problem-solution, they show no clear profile for collaboration and market orientation, but a more competition oriented process, as would be expected in the mass-product situation.

As a result, innovation problem solving processes in integrator situations can be described as collaboration and market oriented.

#### **Discussion, conclusions and basic hypothesis one.**

The fact that an ideal type organisation has been found in the integrator situation allows us to conclude that the situation as such exists. The fact that two further organisations that provide integrated solutions are more oriented in a way which would be expected in the two neighbouring situations, raises the question about the discriminatory power of the dimensions that describe organisational situations. In the two situations where customer problem solving orientation is high, it can be seen that customer centricity is higher than in the situations where customer problem solving

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orientation is low. In the two situations where customer problem solving orientation is low, higher orientation towards competition can be found. Along the second dimension of degree of external collaboration, it can be found that in the two situations with lower collaboration, the organisations more strongly emphasise the value of their resources. In the close-to-the-customer situation, this is the customer relationship, and in the commodity situation, this is orientation towards economies of scale. In contrast, in the two situations with higher external collaboration, this emphasis on certain resources is not to be found. The main difference between an integrator and a mass producer is their supplier market orientation. As a result, differences between the two customer oriented situations and the less customer oriented situations can be described more clearly than differences between the collaborating and the non-collaborating situations. In consequence, it can be said that the discriminatory power of the customer orientation dimension is stronger than the collaboration orientation dimension. The reason for this could be that some companies offer more than one product and that they have value chains of different depths. As a result, the orientation toward collaboration is more flexible than customer problem orientation. This can also be an explanation for the fact that two integrator organisations show different orientations to customer problem-solution, but less differences for collaboration orientation. To classify integrators thus depends on the type of product or problem-solution they integrate. To conclude, an ideal-type integrator is not as clearly to be found as organisations in other situations or mixed-form situations.

In order to increase the discriminatory power of situation description, the resolution of the dimensions could be increased. In the current state, the detailed conclusions to be drawn from different situations are already hard to discriminate due to the high complexity and interdependence of influencing factors. As a result, the framework of different situations will be held up and regarded as sufficiently valid. The question as to whether every organisation, product or subunit can be described by the framework has to remain open. The framework provides a comprehensive basis for evaluation of a very broad range of industrial or service organisations in the private sector, and even organisations of product solutions that can be described as being in two situations at a time, can draw their specific conclusions from the framework. In order to draw specific conclusions, the general conclusions for ideal-type situations have to be validated and illustrated. These ideal-types have been described in the theoretical framework and could be found in the data collected. As a result, the data available for analysis and discussion of the theoretical framework will be regarded as sufficient. To conclude, for the reason that ideal types have been found and that other cases can be described as mixed forms, the framework is regarded as sufficiently comprehensive for further evaluation and discussion. In consequence, the basic hypothesis one is defined as follows:

#### **Basic hypothesis one:**

Conceptual innovation problem situations can be described in a comprehensive way by the two dimensions of degree of customer problem-solution and the degree of necessary external collaboration, so that four different ideal-type situations can be described by different innovation problem-solving foci.

The following figure summarises the different innovation foci in the four situations.

<b>General findings about the four situations.</b>			
<b>Degree of customer problem solution high.</b>	<p><b>Close-to-the-customer problem solution.</b></p> <ul style="list-style-type: none"> <li>• Client relationship centrality.</li> <li>• Client problem focus.</li> <li>• Project orientation.</li> <li>• No explicit or unstructured development process.</li> <li>• Learning orientation.</li> </ul>	<p><b>Integrated problem solution.</b></p> <ul style="list-style-type: none"> <li>• Collaboration and market orientation.</li> <li>• Focus on client problem and market supply.</li> <li>• Orientation toward maintaining integrator position.</li> </ul>	
	<b>Degree of customer problem solution low.</b>	<p><b>Commodity problem solution.</b></p> <ul style="list-style-type: none"> <li>• Economies of scales orientation.</li> <li>• Focus on process technology and process efficiency.</li> <li>• Customer problem identification for existing solutions and facilities.</li> </ul>	<p><b>Complex mass-product problem solution.</b></p> <ul style="list-style-type: none"> <li>• Market and competition orientation.</li> <li>• Balanced importance of resources.</li> <li>• Focus on technological possibilities and market demand.</li> <li>• Competitor orientation.</li> </ul>
		<b>Degree of collaboration low.</b>	<b>Degree of collaboration high.</b>

Figure 30: Specific attributes in the four different innovation problem solving situations, developed by the author.

### 6.3.2 Analysis and Discussion of Methods Related Findings.

In section four, the role of methods was identified and defined as a means for information collection, processing, and communication. Due to the satisficing behaviour of individuals, methods are supposed to improve the quality of information and communication processes, as they can facilitate and provide structure to the process of innovation conception in an ambiguous and unstructured environment. In the previous steps, the role of methods has been described and the concept of methods has been operationalised. In the subsequent paragraphs, these two issues will be discussed.

#### **The role of methods is to support problem solving processes.**

Proposition 0.1 suggests that in addition to the satisficing behaviour of individuals, organisations are economic actors who seek to optimise their effort in decision making and problem solving. In this context, methods can help to increase organisational efficiency. However, efficiency is not the only criterion for method evaluation. Result effectiveness is a more important factor, as innovation conception processes aim to meet strategic objectives. The case study findings provide insights about the application of methods in practice, and four major findings can be described that give an

impression about method usage. The findings help to understand and determine requirements and prerequisites for isolated methods analysis and for integrated implementation.

### **Methods evolve and develop over time.**

As shown in chapter four, method selection is influenced by objective, organisational, and individual factors. When organisations and individuals face similar problems over time, methods establish as part of organisational problem solving routines. When an individual or an organisation faces a completely new problem, then new methods are explicitly searched and developed in order to deal with the new problem. This finding is confirmed by case interviews at case 1, case 4, case 8, case 10, who have stated that the how is more important in completely new problem situations, and that otherwise methods are not an explicit issue.

### **Explicit methods application takes place mainly in larger organisations.**

In large organisations, communication between individuals is an issue that needs to be addressed more explicitly and in a structured way. As in day to day processes it cannot be assured that all individuals have the occasion to communicate with all relevant communication partners (Picot, 1993). Therefore, methods are implemented or made explicit as part of the process definition of the organisation. As a result, in larger organisations, methods are applied more explicitly than in smaller organisations. This finding is confirmed by all larger case study organisations (case 7, case 9, case 11, case 12).

### **Methods are offered by an organisation, and they can be applied by individuals.**

Individuals only apply the methods when specific information is requested in the organisational context, or when they consider specific methods as relevant themselves, and when they are in the position to apply the methods. This finding can be interpreted by objective, organisational, and individual factors. However, the case studies showed that satisficing seems to be a strong factor, so that O'Reilly's (1983) hypotheses about organisational and individual information collection behaviour appear to have more influence than expected in chapter four. In nine of twelve case studies, the interview partners reported a behaviour that can be described as methodological pragmatism. This means that individuals only apply methods when it is absolutely necessary by organisational or objective circumstances, but they work more intuitively whenever it is possible.

### **Methods are specific to problems and project contexts.**

In consequence, methods have to be designed to be appropriately flexible and abstract, and not too problem specific. When too many existing methods are applied to evaluate a new problem-solution, it may be evaluated with the measures of previous and thus different problem-solutions. As a result, a new concept may be rejected due to the application of inappropriate evaluation methods. In consequence, methods can be used as positive satisficing instruments that confirm the appropriateness of a problem-solution, or as negative satisficing instruments with the result that new concepts do not fit into rigid systems of methods and thus are rejected. This finding was supported by cases 7, 10, 11, and 12. Here the interviewees reported that methods often are used by individuals to reach their individual objectives, which is also confirmed by O'Reilly's (1983) findings. The major finding is therefore, that overuse of methods may lead to concept rejection or inappropriate concept acceptance. This can be a reason for methodological pragmatism and thus the avoidance of overuse of methods in order to protect new concepts from rejection. On the other hand,



the risk arises to keep new concepts alive for too long, because methods are applied in order to satisfy positive criteria.

Vice versa, the reasons for non-application of methods can thus be found in objective, organisational and individual factors. From an objective perspective, the problem may be too familiar or too new to the organisation and the individuals to make methods necessary, or in the second case lead to the problem that no methods exist to deal with the problem. From an organisational perspective, methods might not be offered, or specific information delivered by method application is not requested by organisational processes. From an individual perspective, individuals might not have the qualification or the motivation or personal interest to apply methods. These three factors result in the concepts of methodological pragmatism and implicitness of methods application.

To summarise, the four findings do not aim to describe generalised and significant research results, but analytical findings developed out of theoretical discussion and empirical findings. The statements developed illustrate the complexity and subtlety of appropriate method selection, their application, and their organisational implementation. Cooper (1993) and Khurana/Rosenthal (1998) assume that a more structured, methodologically guided, and well-defined process gains effectiveness and efficiency. On the other hand, the constructs of methodological pragmatism, satisficing, and method specificity make process definition hard to pursue. It has been shown in chapters two and five, that to date no structured, general proceeding for the early stages of innovation conception exists. The described problem may be one explanation for this circumstance. To conclude, a guideline for the early stage innovation conception phase on the one hand has to increase and enable an efficient procedure that reduces ambiguity, but also has to remain open and flexible to allow adaption to new problems. Requirements for this procedure will be developed in the context of activity modules in a later section. The following figure summarises the findings:

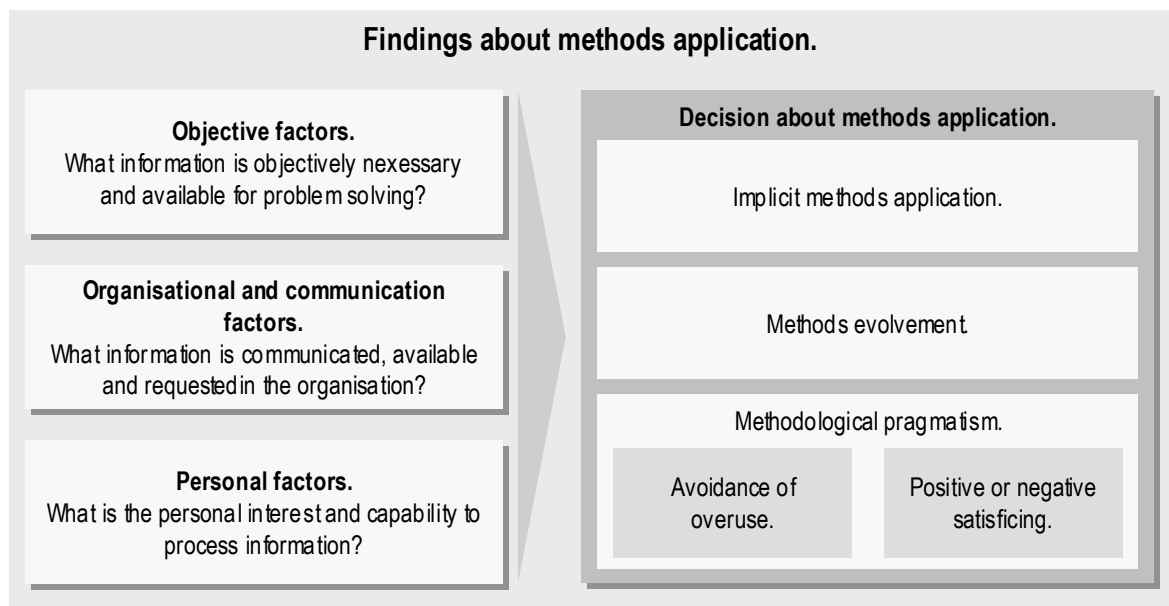


Figure 31: Summary of methods related findings, developed by the author.

### **Evaluation of methods operationalisation.**

The concept of methods in pre-project processes has been divided into three sub categories: Identification and collection of information, evaluation of information, and communication methods. As this research focuses on objective factors that influence method selection, and due to the fact that communication methods are strongly dependent on organisational factors, it was decided to only analyse identification and evaluation methods (see chapter five). Methods have been operationalised by the variables of research approach (qualitative/quantitative), mode of triangulation (sequence, degree), information sources (type, locus), synchronicity of media, richness of transformation form, and formalisation and standardisation of methods. The case study results show that methods are not perceived in such differentiation by the interviewees. In order to gain more detailed data, a quantitative approach is necessary, because the conducted qualitative approach does not allow representative and significant findings. The main differences to be found were between identification and collection methods, and methods for evaluation. The findings show that identification and collection techniques are mostly based on qualitative, structured approaches, relying on many information sources, and that evaluation techniques aim to quantify information in order to allow structured and possibly unambiguous evaluation of information and to enable appropriate decision-making. Examples for this quantification are to be found in market size, cost, or collaboration partner evaluation. Especially in large commodity, large mass-product, and large integrator organisations, this approach to quantification in evaluation of information was found. According to O'Reilly (1983), in larger organisations quantitative information is seen as more trusted than unstructured, qualitative information is. Size of organisations may be one reason for quantification of evaluation techniques. In particular, organisations in a less mature stage, aiming for large markets also tend to evaluate information quantitatively and in a more structured way than close-to-the customer and smaller integrator organisations. This might be due to a correlation between organisation size and currently addressed market size, which implies that commodity organisations and mass-product organisations might become larger by their nature. Therefore, more quantitative evaluation techniques are proposed to be found in commodity, complex mass-product, and mass-product oriented integrator organisations. The following figure illustrates the findings:

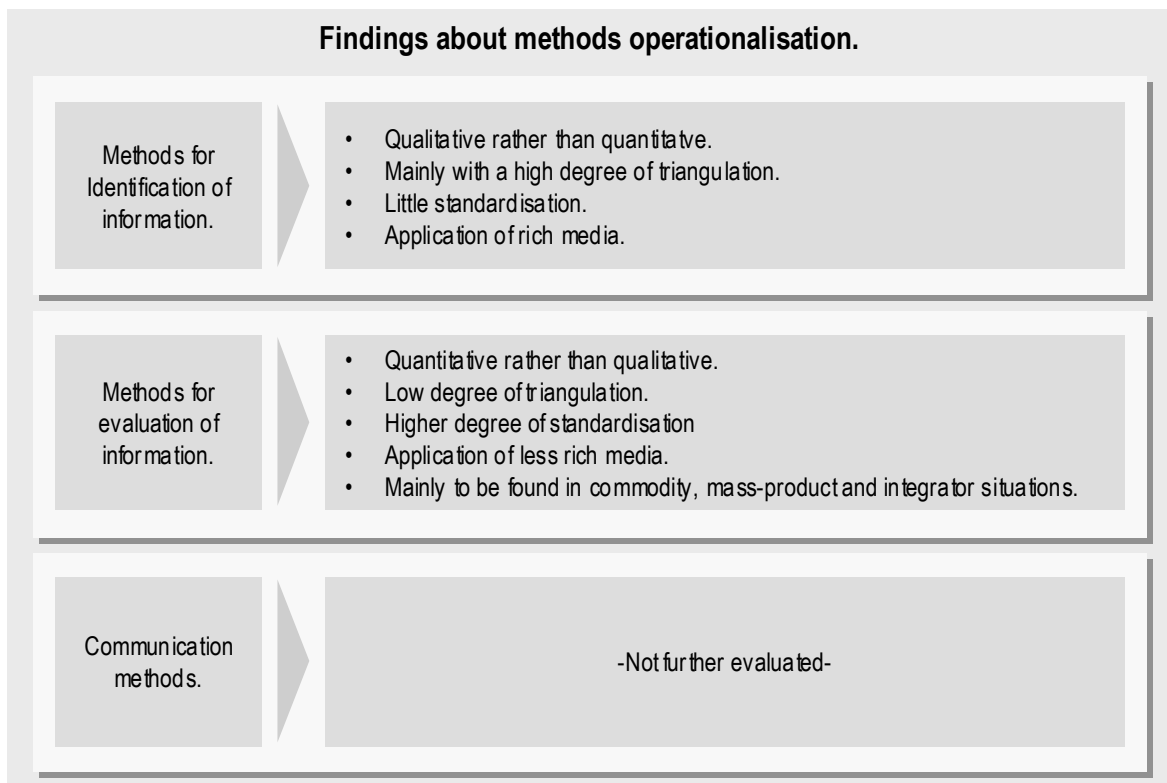


Figure 32: Findings about methods operationalisation, developed by the author.

### Conclusions for methods related findings.

To summarise, differences related to identification methods cannot be identified due to a lack of representativity and significance of findings, while identification techniques in commodity, mass-product, and mass-product related integrator organisations are identified and tend to be more quantitative. On the methodological level, no further remarkable differences were found between the situations. However, it was the aim to understand the different innovation problem foci and to use method application in order to illustrate these differences. As shown in the previous sections, the innovation problems in the four situations are different to each other, ideal type situations have been identified and organisations not belonging to a specific situation can be described as mixed forms, so that the framework can be regarded as comprehensive.

The appropriate selection of methods in different problem situations bears high potential to improve innovation success (see chapter five), and it has been found that methods are not selected and applied in a differentiated way in relation to problem situations. However, ideal-type and mixed form problem situations have been identified. Thus, the analysis of problem situations will allow a more differentiated view on innovation problems and thus on appropriate methods selection. Next, the problem situations as found in empirical data, will be analysed and set into relation with appropriateness to innovation success. It was not the aim to test propositions or hypotheses, but to illustrate, evaluate and validate the theoretical framework. In consequence, the fact that the propositions developed in chapter five could not be verified in detail does not mean that the variables and propositions are not helpful. The variables still provide a basis for organisational intervention and evaluation in a later quantitative analysis. The approach to develop requirements for method selection cannot aim for detailed method description, but has to use the situation-specific problem as

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a basis. Next, the problem itself in different organisational situations will be the object of analysis. As a result, hypotheses will be developed on the basis of the four problem situations in relation to innovation success. Assuming the successful organisational and individual implementation of methods in the pre-project innovation phase, requirements for methods will be developed that are proposed to improve successful conception of innovations. To conclude, the basic hypothesis two, which serves as a fundament for the further process is as follows:

### **Basic Hypothesis two:**

The situation-related appropriate application of methods in pre-project innovation processes leads to more successful pre-project phase results and thus to potentially higher innovation success, provided the appropriate and successful organisational implementation of methods, and the appropriate qualification and motivation of individuals.

The following figure illustrates basic hypothesis two:

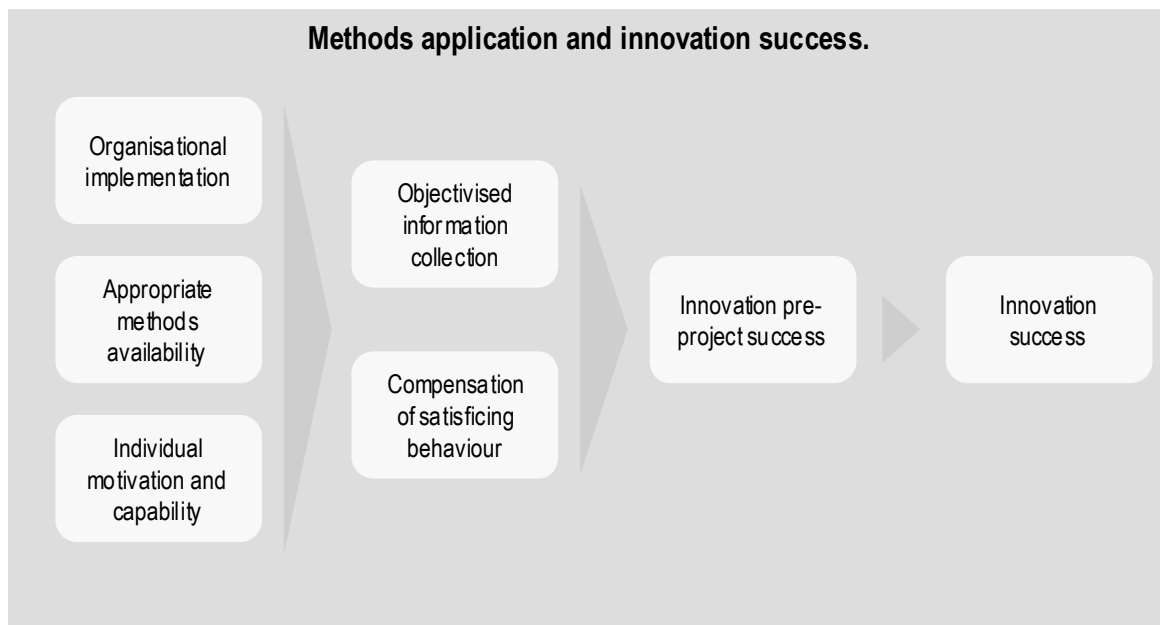


Figure 33: Methods application and innovation success, developed by the author.

### **6.3.3 Discussion of Activity Modules Related Findings.**

In the previous two sections, basic hypotheses have been developed about the existence of four different organisational situations, and about methods application in general. It is the objective of this section to develop a basic hypothesis about the linkage between methods application and organisational situations. On the basis of this linking hypothesis, detailed requirements for method selection in different organisational situations will be developed.

In order to describe the pre-project innovation phase on a conceptual level, the concept of activity modules was introduced in chapter five, as a measure to distinguish different activities in the early innovation problem solving process. The modules have been derived from theoretical and practical methodological considerations. The aim was to provide a structure that allows the pre-project phase to be analysed in a comprehensive, but not too detailed way. Thus, the question as to whether the

structure and combination of the modules represents reality is not as important as the question about comprehensiveness of the modules is. In all case studies, the concept and content of modules was discussed and validated by the interviewees and thus, the four modules will be regarded as sufficiently valid. As a result, basic hypothesis three can be described as follows:

**Basic hypothesis three:**

Conceptual problem solving processes and the pre-project innovation phase can be described in a comprehensive and sufficiently valid way by the four described activity modules (customer needs and market potential, technology and problem-solution, competition and co-operation, and proceeding, fit and feasibility).

The following figure illustrates how hypotheses one, two and three build one framework. Although this research is focused on objective factors, organisational and personal factors are important components for accessing the topic via real-world case studies, as otherwise only an experiment could help to validate the developed theoretical framework. The figure summarises the most important findings and theoretical results: First of all, method selection has an influence on innovation problem solving. Method selection is defined by personal, organisational and objective factors. Due to satisficing on an organisational and personal level, methodological pragmatism leads to the limited quality of problem-solving processes. These limitations can be compensated by appropriate method selection, which is also influenced by objective factors. These are defined by four situations and their respective innovation problem solving focus, and by four activity modules.

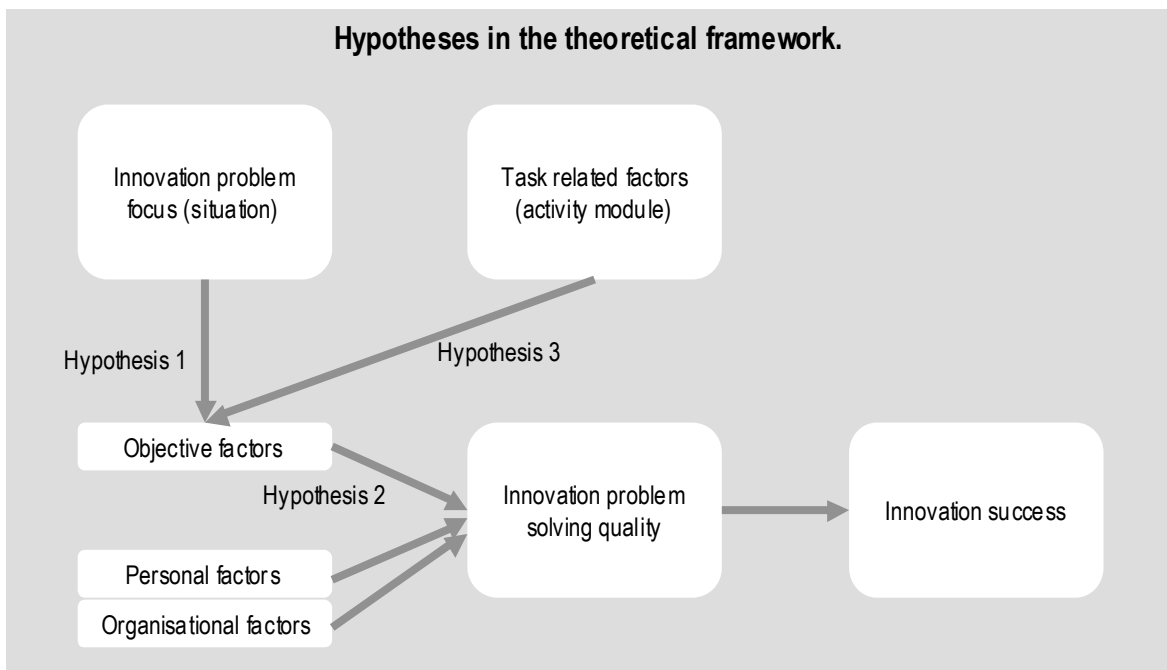


Figure 34: Hypotheses in the theoretical framework, developed by the author.

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In this section, the theoretical framework was illustrated and validated. The result is, that the the four situations exist, that the activity modules are comprehensive and that they describe the actual problem in each situation. In the next section it needs to be clarified, whether the proposed method approaches are appropriate. Thus, requirements for the selection of methods in the pre-project innovation phase in different organisational situations will be developed on the basis of the three basic hypotheses. It has been shown that no detailed differences for methods selection have been identified between the situations. Thus, the requirements will focus on an evaluation of problem definitions in each situation and module.

## **6.4 Requirements for the Selection of Methods in Different Organisational Situations.**

In the previous sections, basic hypotheses have been made that refer to the quality of the theoretical framework. The findings show that methods are not applied with the expected explicitness and that methods application cannot be described in the same detail as they were in the developed propositions. According to basic hypothesis two, the appropriate application of methods can improve innovation pre-project phase success. On the basis of this hypothesis and grounded on the empirical findings, in the following sections, requirements for methods selection in the different situations will be developed. In the final step, general findings and requirements will be summarised per activity module to conclude the findings of this research.

### **6.4.1 Requirements for the Close-to-the-Customer Situation.**

In this section, requirements for method selection in pre-project phases in the close-to-the-customer situation will be developed. The requirements are grounded on a discussion of the propositions developed in the theoretical framework and of the empirical findings from the case study research. The requirements will be discussed in two steps. First, the three differentiating activity modules will be discussed, and then the resulting innovation problem solving focus will be derived.

#### **Requirements for the customer needs and market potential module.**

In this situation, customer needs were proposed to be highly multidimensional, specific to a very high degree, and not very explicable (proposition 1.1). In the relevant cases (cases 1,2 and 3), multidimensionality and interdependence of needs were confirmed. However, specificity of needs was not as high as expected, especially in cases 1 and 3. Here, customer needs have a similar structure, but individual weightings. Values and effects of variables vary between customers. As a result, the proceeding for need satisfaction can be standardised to a certain degree, and thus customer needs can be made partially explicit. This is only possible by maintaining a close relationship to the clients. In order to identify and evaluate customer needs in the close-to-the-customer situation, this close relationship to the customer is the key strength of innovating organisations.

From these findings, the following requirements result: The identification of customer needs should use the opportunity of the close customer relationship. The approach should be more qualitative and focus on the existing customers. Thus, a focus on triangulation would not be efficient in this situation. In contrast here, rich, less formalised and standardised communication is seen as appropriate (e.g. key client workshops). The evaluation of customer needs and their effects on perceived value also should be conducted in close relationship to the clients, by using rich, less standardised communication methods (e.g. in the course of proposal discussions).

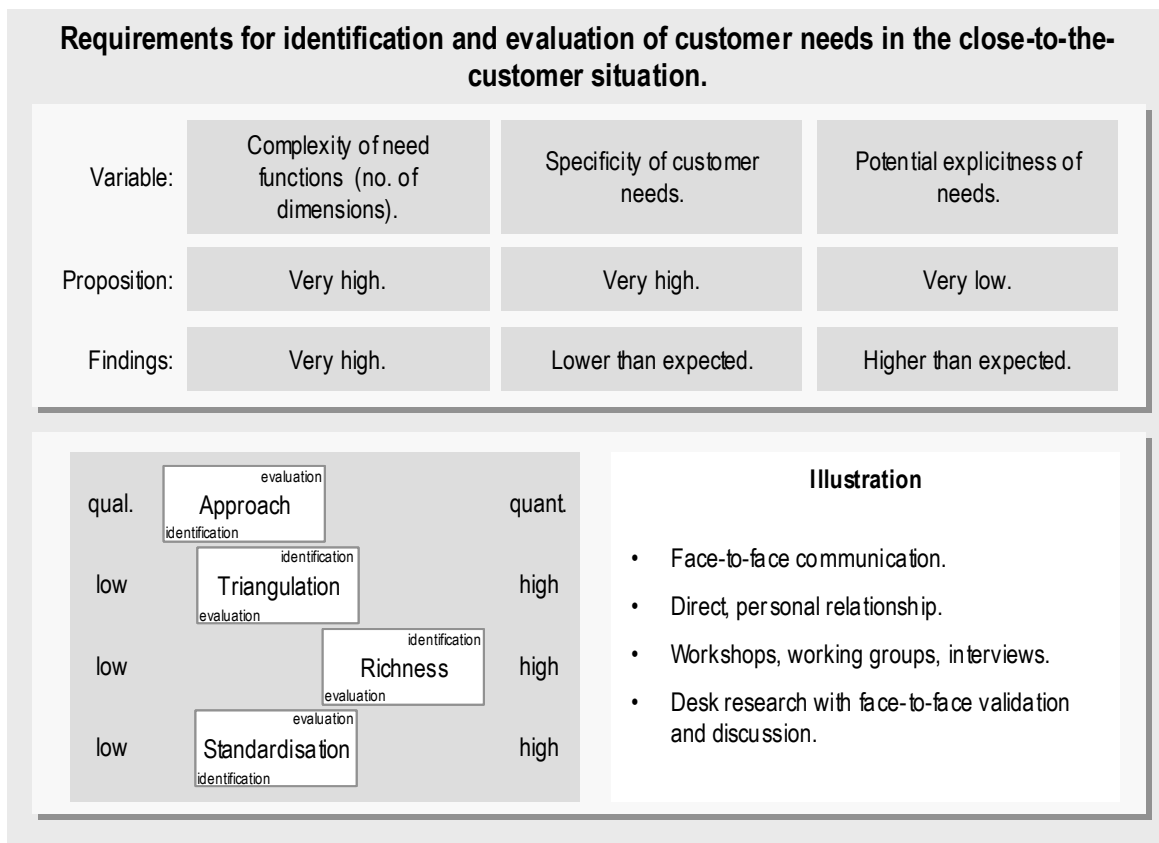


Figure 35: Requirements for method selection in the market module in the close-to-the-customer situation, developed by the author.

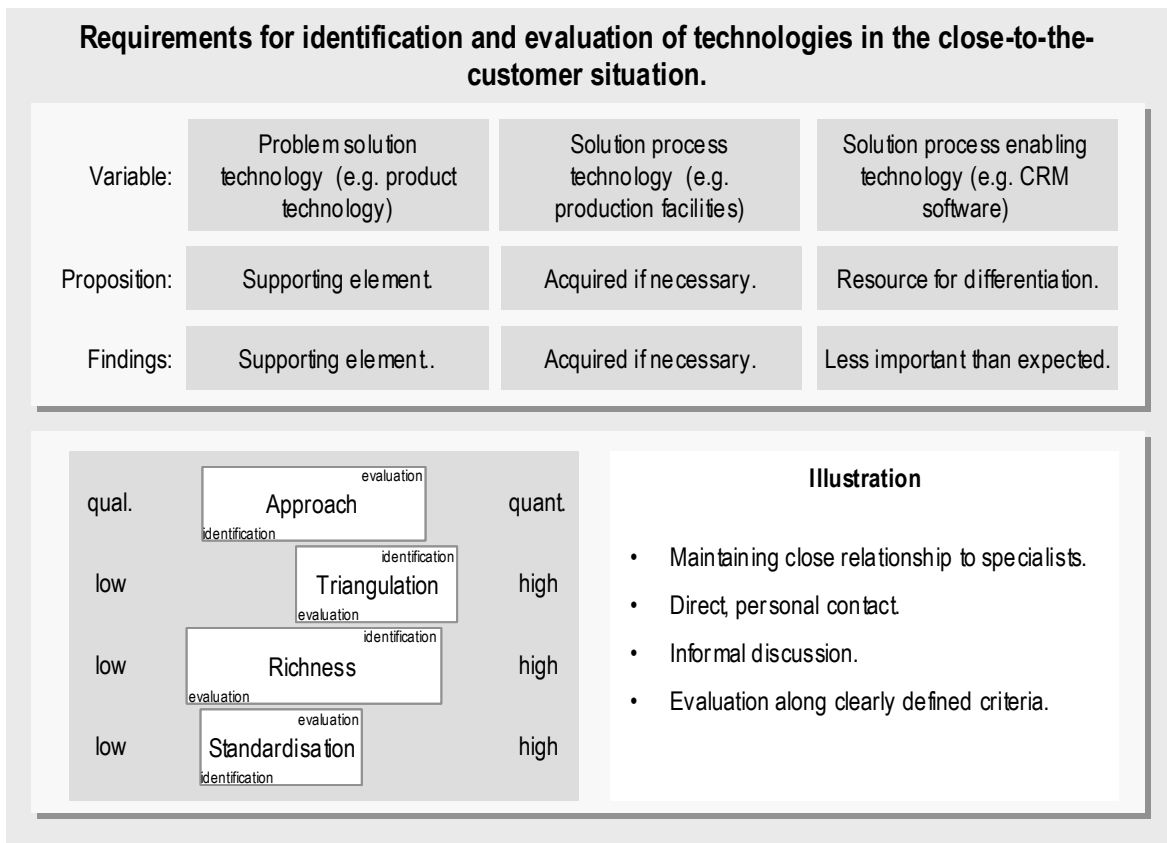
### Requirements for the technology and problem-solution module.

In this situation, technologies were proposed to be supporting elements for the problem-solution. If they are needed for the problem solving process, they were assumed to be acquired, and as process enablers they were seen as potential resources for differentiation (proposition 1.2). Not all three types of technologies are necessarily relevant in every case.

In two of the three relevant cases (1 and 3), the problem-solutions are not of a technological type, while in the third case the problem-solution lies in applicable technology. In this third case (case 2), technology is the key component of the problem-solution, as they develop search engines and other knowledge management software. However, the technology is of no use to the clients, if it is not implemented into the clients' existing IT systems, and the working processes are not adapted. As a result, this close to the customer service situation is also similar to a complex mass product situation. Considering the delivered problem-solution as an integrated knowledge management process, then technology is only one component of the solution. It has to be acknowledged, that this organisation is in a hybrid situation between a complex mass products and a close-to-the customer service situation. Interpreting the solutions in this way, the proposition about problem-solution technology can be held. In all the three relevant cases, problem solving process technology was standardised and not of highest strategic importance, and thus as expected, externally acquired. Problem solving enabling technologies, which could be used for customer retention, are not relevant in these cases, although in the hybrid position case (case 2), the technological problem-solution that is sold is one factor to maintain the customer relationship.



From these findings, the following requirements result: The identification of product technologies, problem solving process, and problem solving process enabling technologies are oriented toward external acquisition and thus oriented towards the market. In consequence, identification follows a more qualitative approach with high methods and sources triangulation. Different sources with all kinds of communication methods are used, like scientific journals, technology magazines, and face-to-face communication. Thus, communication is of little structure. The evaluation of technologies will follow a more quantitative approach, technologies have to be evaluated according to the measures defined in the market module. Thus, methods here have a higher potential for structuredness and standardisation.



**Figure 36: Requirements for method selection in the technology module in the close-to-the-customer situation, developed by the author.**

**Requirements for the competition and collaboration module.**

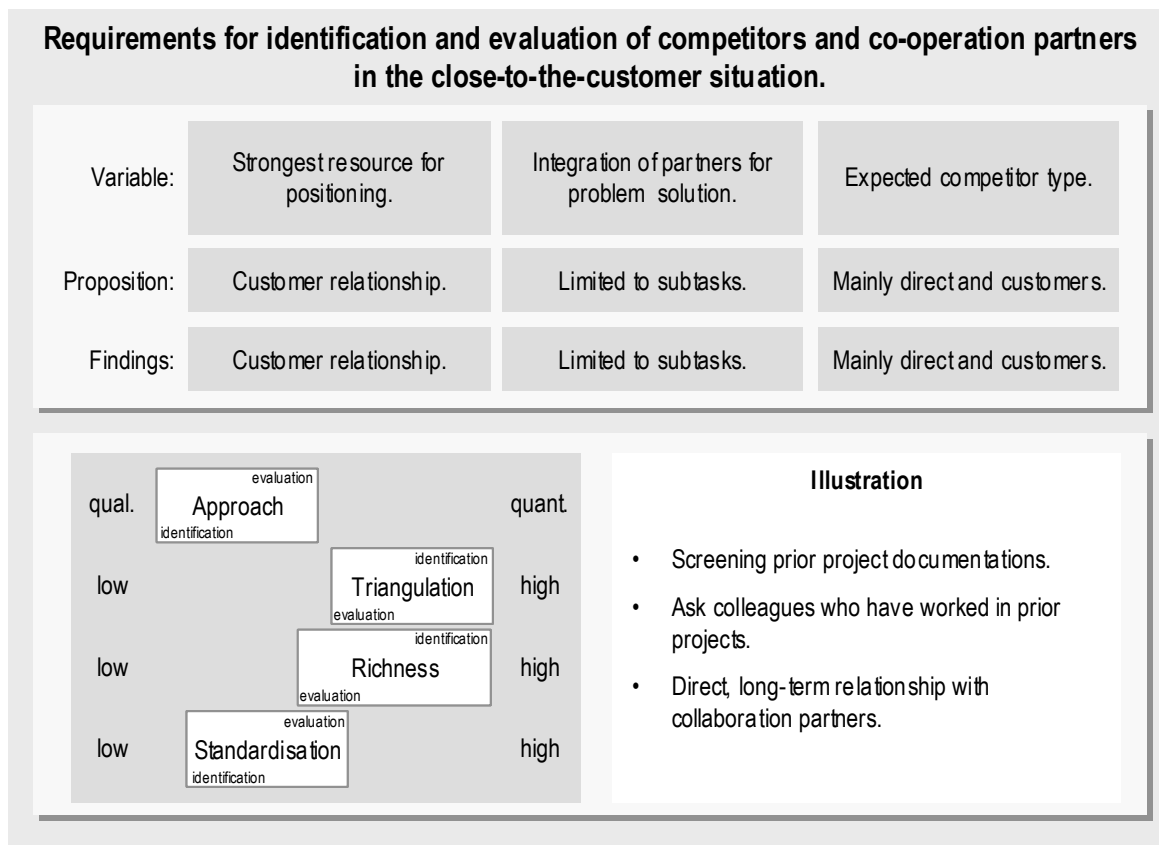
In this situation, the strongest resource for positioning was assumed to be the customer relationship. Collaboration partners for solving customer problems were assumed to be involved only for limited subtasks, and competitors were mainly found as direct competitors and among customers themselves (proposition 1.3).

In the three relevant cases, it can be confirmed that the customer relationship is the strongest resource in combination with specific problem solving capabilities. In the hybrid case (case 2), the problem solving capability lies also in technological competence. In all three cases, collaboration is limited to defined subtasks, where collaboration partners are not an important factor for differentiation. Further, in all three cases, competitors were mainly to be found in direct competitors and in the clients themselves. As a result, proposition 1.3 can be regarded as confirmed.

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From these findings, the following requirements result: The identification of collaboration partners is oriented along the necessary complementary problem-solutions. As organisations in this situation are mostly project oriented, they normally identify and evaluate partners for specific projects. In consequence, identification of collaboration partners is in the first step oriented towards previous projects that have been conducted together, and in the second step oriented towards the market. As with technologies, the identification follows a more qualitative approach with high methods and sources triangulation. Different sources with all kinds of communication methods are used, like scientific journals, technology magazines, and face-to-face communication. The evaluation of collaboration partners is also conducted in the course of a project, by applying more quantitative measures. Thus, evaluation here follows a more quantitative approach, but with less potential for standardisation and formalisation due to the project environment.

The identification of competitors is also qualitative, less structured and formalised. Here, competitors cannot be evaluated by exact quantitative measures. However, competitors serve as important sources for information about customer needs. Thus, competitors are used as a further source in addition to existing customer relationship. Evaluation thus is more qualitative, unstructured, and less formalised, but highly triangulated.



**Figure 37: Requirements for method selection in the co-operation and competition module in the close-to-the-customer situation, developed by the author.**

**Resulting innovation problem solving focus in the close-to-the customer situation.**

In this situation, customer needs are identified and evaluated in the course of running projects, technology is identified and evaluated in the course of running projects and oriented toward the market, and the identification of collaboration partners is also integrated in running projects. As a result, almost all activities in the close-to-the-customer situation are taking place in the course of

projects, and thus new concepts are also developed in this way. Only in the case that experience from former projects is not sufficient, new knowledge or information is acquired from outside the organisation. As a result, this situation can be described as learning and project oriented.

#### **6.4.2 Requirements for the Commodity Situation.**

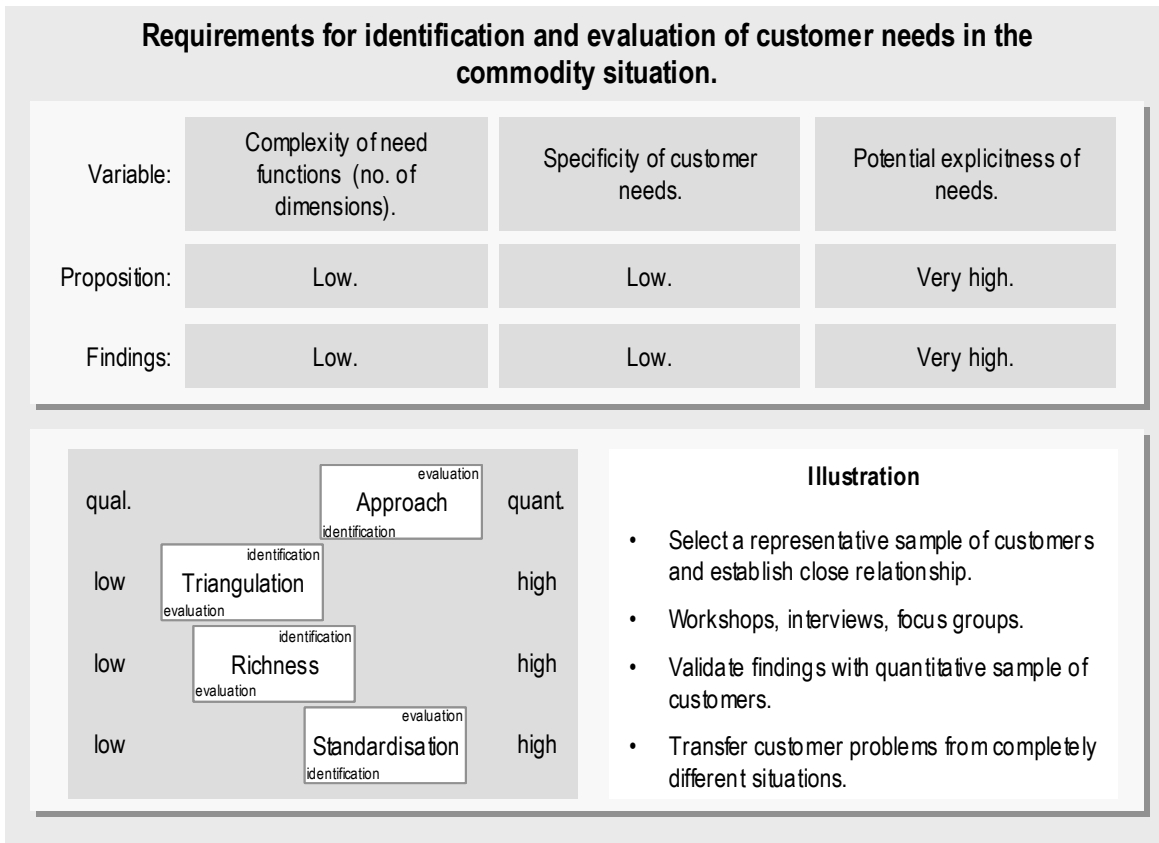
In this section, requirements for method selection in pre-project phases in the commodity situation will be developed. The requirements are grounded on a discussion of the propositions developed in the theoretical framework and of the empirical findings from the case study research. The requirements will be discussed in two steps. First, the three differentiating activity modules will be discussed, and then the resulting innovation problem solving focus will be derived.

##### **Requirements for the customer needs and market potential module.**

In this situation, customer needs were proposed to be low dimensional, non-specific and highly explicable (proposition 2.1). In the relevant cases (cases 4, 5 and 6), these circumstances were confirmed, the criteria to determine customer needs are mainly price, quality and volume of delivered goods or services. As a result, the process for need satisfaction is extremely standardised, and thus customer needs are often assumed to be known.

An important challenge in this situation is to verify the needs of existing clients, to identify further (new) applications of already offered goods and services, and to identify new (further) applications of existing facilities. All three challenges can be met by establishing a closer relationship to existing or new clients. Because in this situation the number of clients is relatively high, representativeness of the observed sample should be given. The identification of new and further applications is a challenge which is not as distinct in other situations. Here, the clients are not the first ones to be contacted (because they are not yet known), but a creative process is the first step in this problem solving process. It is necessary to identify analogies from existing or new problem-solutions to the problem-solutions offered by the innovating organisation. To provide an example, in case 5, perforated sheets were identified to be potentially used as colanders. Then in the next step, the needs of potential colander users had to be identified and understood in order to understand the needs of colander producers.

From these findings, the following requirements result: The identification of customer needs should follow a two-step approach. First, in a creative process further applications have to be identified, and then in the second step, customer needs have to be identified by understanding the needs of customers and their customers. As a result, identification of needs has to follow a qualitative approach, using many and widespread information sources, with little formalised, but rich communication methods. The evaluation of customer needs has to follow a strict quantitative, standardised and formalised approach, as the identified needs and potential problem-solutions need to justify the size of production facilities.



**Figure 38: Requirements for method selection in the market module in the commodity situation, developed by the author.**

**Requirements for the technology and problem-solution module.**

In this situation, technologies were proposed to be central to produce the problem-solution in high quantities at given quality standards. If they are needed for the problem-solution itself, they have to meet defined requirements. Within the problem solving process, they are proposed to be internally developed, and as process enablers, they are seen as a resource for quality (proposition 2.2).

Not all three types of technologies are relevant in every case. In all three relevant cases (cases 4, 5 and 6), the problem-solution is used by their clients in order to produce a more complex product. Here, there are clearly defined quality standards, and in cases 4 and 6, clients ask for samples to test the quality of the problem-solution before they order larger amounts. The most important technology type in all three cases is production technology, which can be interpreted as a problem-solving process technology. All case study organisations are highly focused on their production technology in order to deliver the required product quality. Problem solving process enabling technologies only play a role as customer relationship or logistics supporting technologies, and thus can be seen as resources for the quality of delivery.

From these findings, the following requirements result: In analogy to the identification of customer needs, the identification of additional applications of production technology can be regarded as a creative process aiming to identify additional problem-solution technologies that can be produced with existing facilities. Thus identification methods should be more qualitative in their nature, but also be triangulated to a high degree, little formalised and standardised, but rich. In the second step, the evaluation of technologies should follow a quantitative, formalised and standardised approach. The identification of process technology improvements should be co-ordinated from inside the organisation, together with technology development. Here, technical requirements can be identified

and realised together with external parties. As a result, the approach is rather qualitative than quantitative, and the number of information sources used is proposed to be not as high when compared to market oriented technology identification. In commodity situations like case 5, for example, large scale production facilities cannot be produced by a large number of suppliers due to a limited number of commodity producers. Thus, supplier markets are normally of an oligopolistic structure. Thus, close collaboration with suppliers is the reason for this qualitative approach with limited triangulation. The evaluation of process technology, again should follow a quantitative approach with high potential for standardisation and formalisation. The identification of solution process enabling technology is oriented toward the market and thus highly triangulated, using a high number of information sources with varying richness, to be followed by a quantitative, formalised, standardised evaluation process.

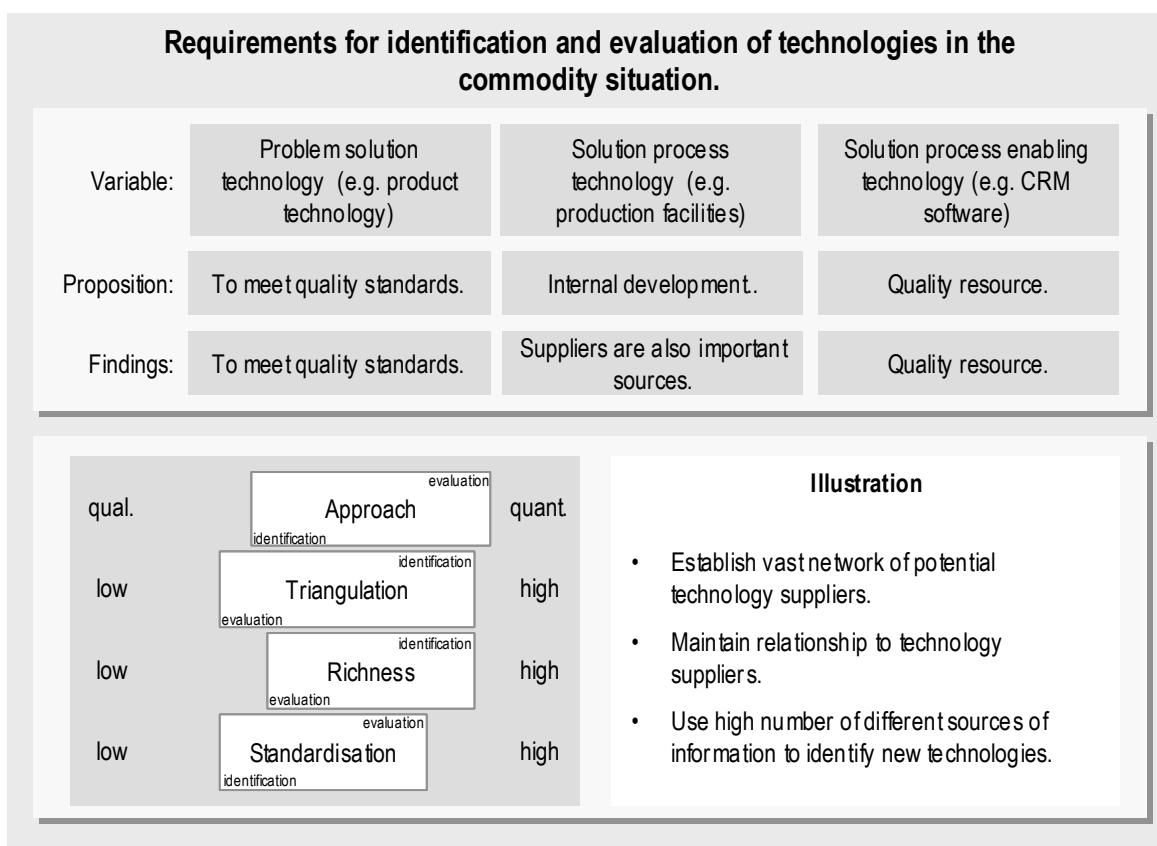


Figure 39: Requirements for method selection in the technology module in the commodity situation, developed by the author.

### Requirements for the competition and collaboration module.

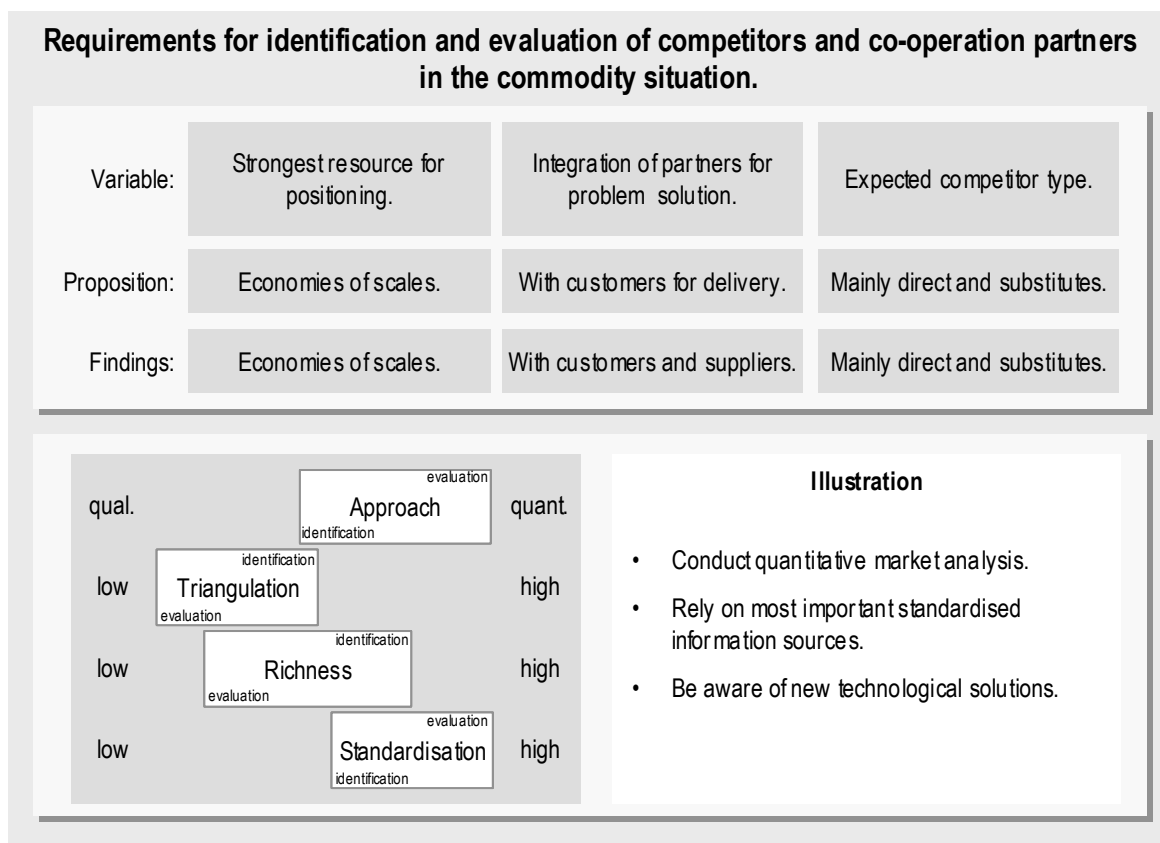
In this situation, the strongest resource for positioning was proposed to be economies of scale. Collaboration partners were proposed to be used for delivery, competitors were supposed to be mainly direct and substitutes (proposition 2.3).

In the three relevant cases, production facilities were identified as the central resources for innovation development, as almost all activities are connected to the production units. Unlike as stated in the proposition, two of the case study organisations mainly collaborate with suppliers to develop their production facilities. Although in all cases, customers are collaboration partners for the definition of the problem-solution to be delivered, the proposition has to be regarded as not sufficiently comprehensive. The importance of suppliers as collaboration partners has to be additionally emphasised. All cases see mainly direct competitors and substitute producers as

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important, while other forms of competitors are of less importance. However, in case 5, for the cheapest product type which is also uncomplicated to produce, also large customers become potential competitors. As a result, here collaboration with customers is increased in order to anticipate their needs and to make processes as smooth and efficient as possible. As a result, collaboration with customers can also be related to potential competition with customers, although this is only relevant in markets where there are only a small number of customers. Thus, the selection of collaboration partners can also be dependent on the complexity of the production process and the market structure.

From these findings, the following requirements result: The identification of collaboration partners should be qualitative, and depending on market structure and production complexity, be less or more triangulated. However, due to the close collaboration with external partners, rich and less standardised and formalised communication is appropriate. The evaluation of collaboration partners should be of quantitative nature, as the defined results can be easily measured in terms of units sold or production costs. The identification of competitors should thus be focused on direct competitors, clients and substitutes. As clients can be collaboration partners, too, they can serve as a good source for understanding customer needs, and to identify substitutes. As a result, the identification should be a more qualitative approach with close, rich, and less standardised communication. The evaluation of competitors should be oriented towards a more quantitative approach with high standardisation potential.



**Figure 40: Requirements for method selection in the co-operation and competition module in the commodity situation, developed by the author.**

### **Resulting innovation problem solving focus in the commodity situation.**

In this situation, customer needs are identified and evaluated along the criteria of price, quality and availability. The identification of problem-solutions is focused on existing production facilities, and the integration of collaboration partners is also oriented at the production facilities and on quality of delivery. As a result, most of the innovation activities in the commodity situation are connected and constrained by the existing production facilities. In consequence, this situation can be described as oriented towards economies of scale.

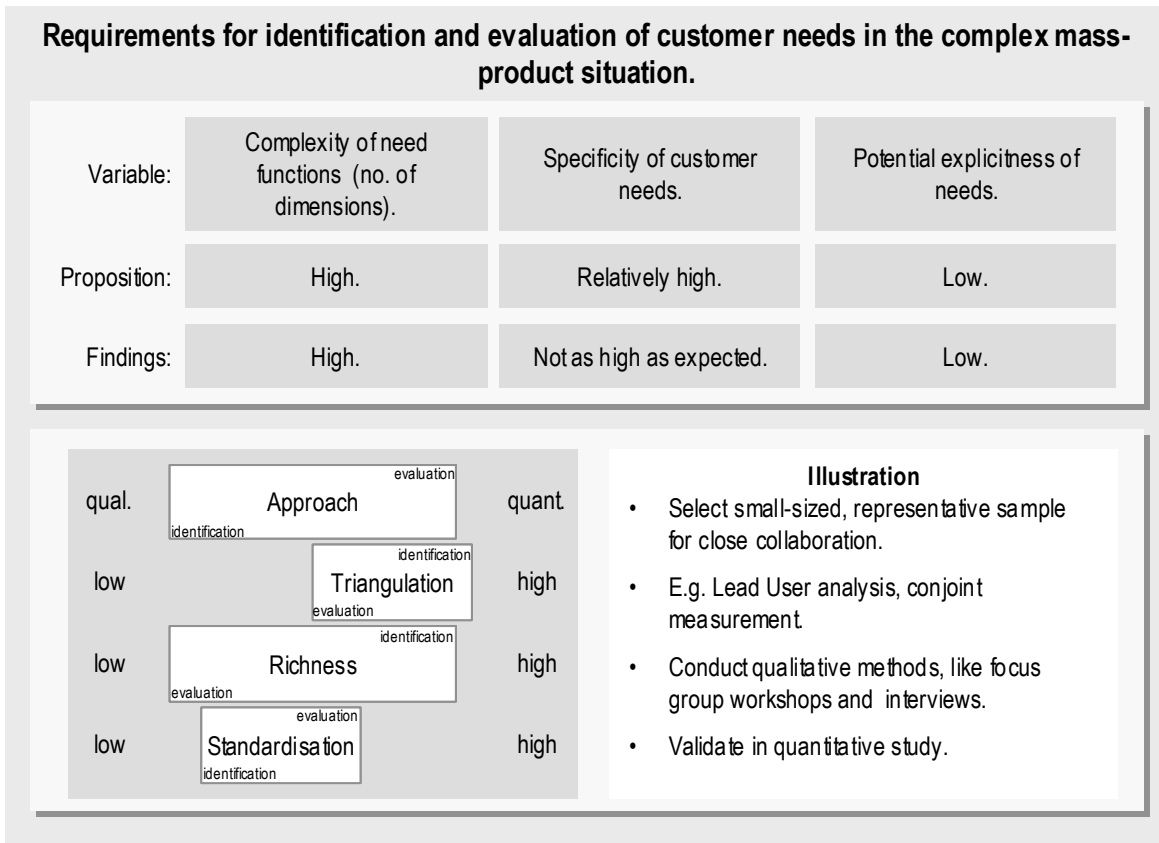
#### **6.4.3 Requirements for the Complex Mass-Product Situation.**

In this section, requirements for method selection in pre-project phases in the complex mass-product situation will be developed. The requirements are grounded on a discussion of the propositions developed in the theoretical framework and of the empirical findings from the conducted case study research. The requirements will be discussed in two steps. First, the three differentiating activity modules will be discussed, and then the resulting innovation problem solving focus will be derived.

#### **Requirements for the customer needs and market potential module.**

In this situation, the number of customer need dimensions was proposed to be high, specificity of needs was proposed to be relatively high, and explicability of needs was proposed to be low (proposition 3.1). In the relevant cases (cases 8, 9 and 10), the high number of need dimensions was confirmed, due to the different contexts of product application. The specificity of needs however has not been found to be as high as expected. Especially in consumer goods (case 9), the social aspects of purchasing a product have been stressed. Further, in cases 8 and 10, customer needs depend on their respective customers' needs and on the legal environment. Thus, customer needs can be described as specific to a group of customers, but not as specific to each customer. Because problem-solutions and sales are standardised, contact with the customers is limited and thus, customer needs are not always present. In case 10, for example the customer services have been outsourced for a certain period. As soon as the management realised that customer contact is extremely important for their product development, they have re-integrated this process. Customer needs are still multidimensional, and the weighting of each of the dimensions is individual, and further this weighting cannot be expressed completely.

In order to meet these challenges, the following requirements result: The identification of customer needs should compensate the missing link to the customers, and should to consider different customer groups. As a result, the identification needs to be a more qualitative approach, focusing on representative samples of customers (like focus groups). As a result, here more rich, less standardised and formalised communication methods are appropriate. The evaluation of customer needs has to meet the size of production facilities on the one hand, and the potential heterogeneity of customer groups on the other. Thus, more statistical, quantitative approaches appear appropriate. Standardised formal methods, like conjoint measurement can be found here.



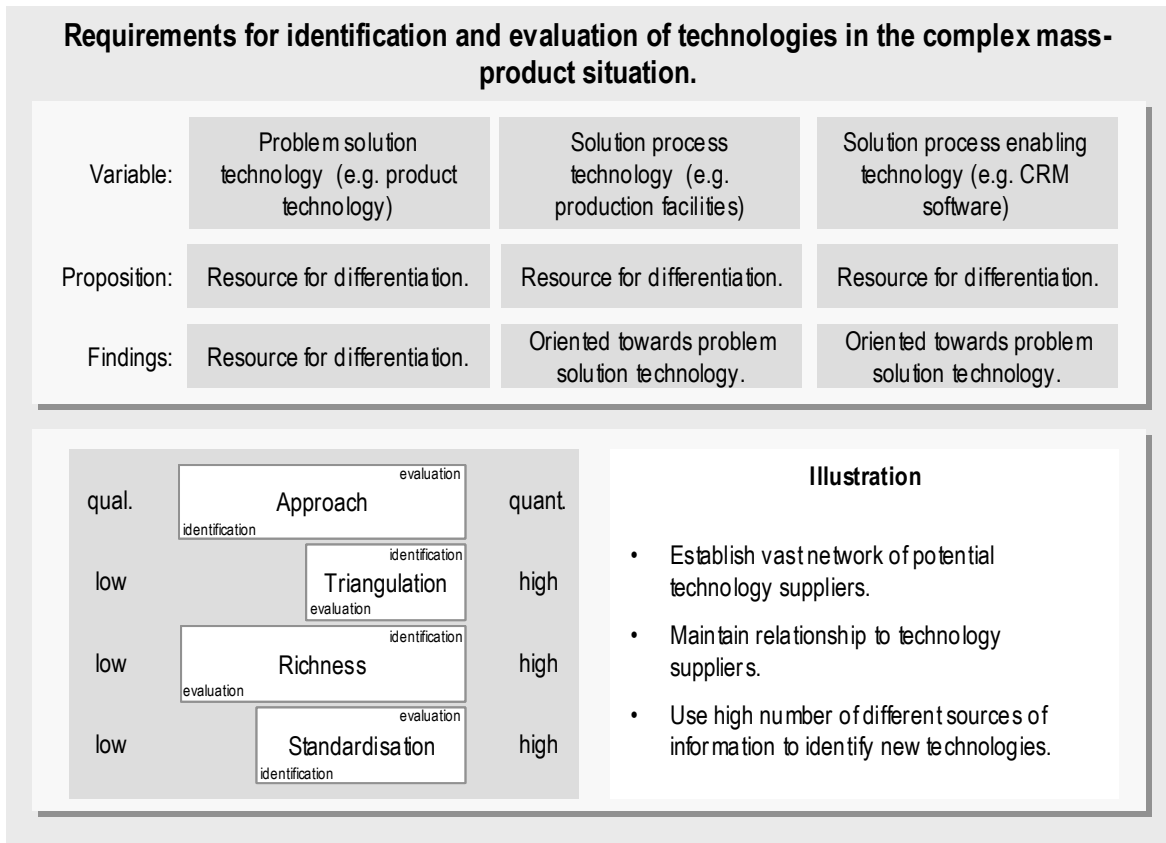
**Figure 41: Requirements for method selection in the market module in the mass-product situation, developed by the author.**

**Requirements for the technology and problem-solution module.**

In this situation, all three types of technologies were proposed to be potential resources for differentiation (proposition 3.2). In the relevant cases (cases 8, 9 and 10), especially problem-solution technology was identified as the most important asset, while problem-solving process technology and also enabling technologies were of little importance. In all cases, the current technology is developed and modified in order to meet customers requirements. Problem-solving process technologies are co-developed together with the solution technology, and also enabling technologies like software applications are co-developed following the requirements of the problem-solution technology.

From these findings, the following requirements result: The identification of problem-solution technologies is oriented toward existing and potential customer needs, and thus the identification of all three technology types should be of a more qualitative orientation with the aim to define further requirements for enabling and problem solving process technology. Thus, high triangulation of sources and methods, varying synchronicity, less standardisation and less formalisation is appropriate. The evaluation of technology however has to be oriented toward the requirements defined by existing technology requirements and customer need requirements. As not all of these requirements can be of a strict, quantitative kind, evaluation needs to be as quantitative as determined by the requirements, but highly structured and formalised, with communication techniques of low richness.





**Figure 42: Requirements for method selection in the technology module in the mass-product situation, developed by the author.**

**Requirements for the competition and collaboration module.**

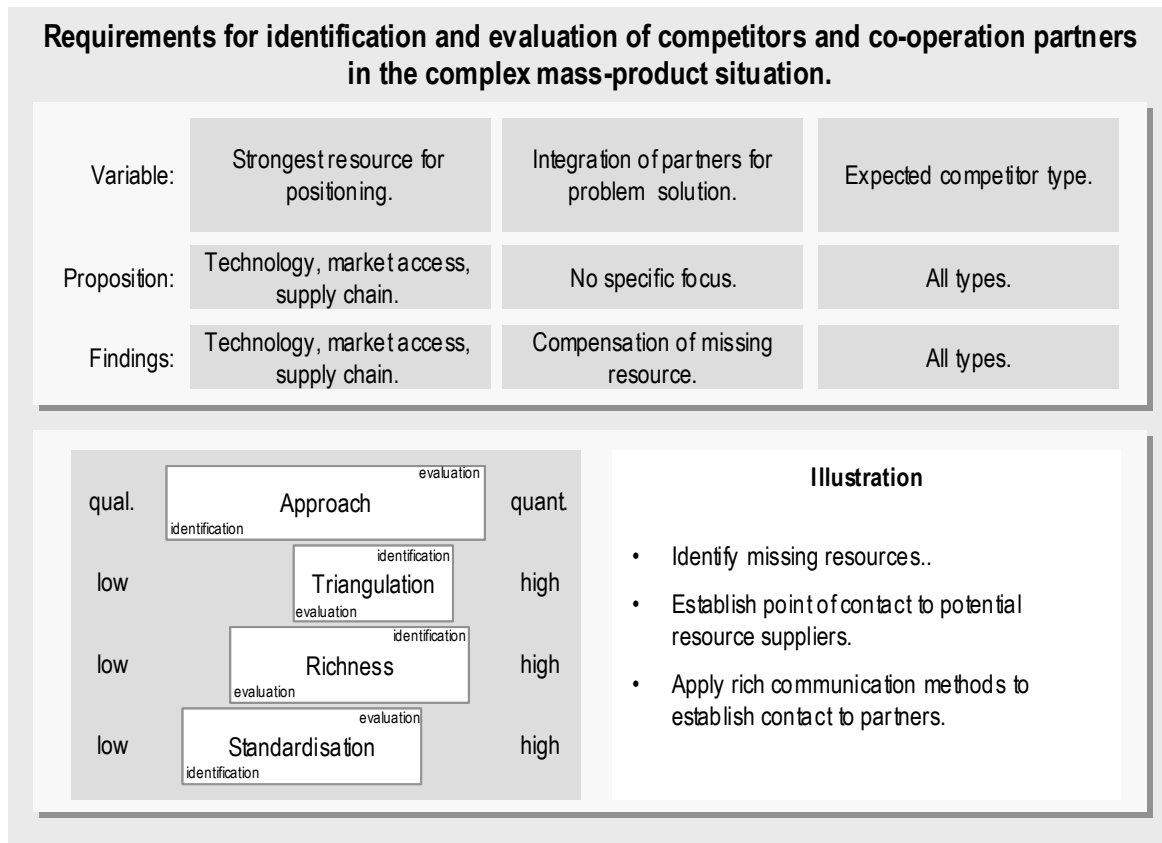
In this situation, the strongest resource for positioning was assumed to be market access, technology access and a strong supply chain. Collaboration partners are expected to be involved to compensate missing resources. Competitors were expected to be found of all types (proposition 3.3).

In the relevant cases, no specific resource for positioning could be identified. All interviewees stated that all types of resources were important, and that no specific resource could be identified as more important than the others. Further, in all three cases it was reported that co-operation partners were selected for the compensation of the absence of specific resources. Further, competitors were seen as being of less importance than expected. Due to the low specificity of customer needs and due to the many different substitutes, competitors were not seen as important sources for information concerning the early innovation process. Only in one case (case 10), information about competitors was identified as being of added value due to the different product qualities of the own product and the competitor's product. Because competitor information was available, customer needs explication could be supported and an additional feature was developed.

From these findings, the following requirements result: The identification of collaboration partners needs to be oriented along existing and missing resources. If there is no existing contact to potential and former collaboration partners, these need to be identified from the market, using a qualitative, highly triangulated approach. Due to the complexity of the topic, evaluation needs to be more qualitative due to the low potential for quantification. Thus, rich, unstructured, less formalised and standardised communication methods are appropriate for identification and evaluation. The identification of competitors is only relevant for directly competitive solutions. In general, the identification of competitors has the potential to evaluate investment risks, but this problem seems to

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be of limited interest to the evaluated case studies. Due to the many different kinds of competitors, identification and evaluation of competitors needs to be highly triangulated, using many different sources and communication methods of varying richness. Evaluation of competitors needs to be as quantitative as possible, however the availability of information about competitors will restrict a quantitative, structured and formalised evaluation.



**Figure 43: Requirements for method selection in the co-operation and competition module in the mass-product situation, developed by the author.**

**Resulting innovation problem solving focus in the complex mass-product situation.**

In this situation, the identification and evaluation of customer needs, of technologies, collaboration partners and competitors is influenced by the specific situation of a mass-market. Customer needs are multidimensional and specific to groups of customers. Problem-solution technologies are evaluated in order to meet requirements evolving from these diverse needs. As a result, competition takes place on several different levels to meet the customers' needs and thus, this situation can be described as competition and market oriented.

**6.4.4 Requirements for the Integrator Situation.**

In this section, requirements for method selection in pre-project phases in the integrator situation will be developed. The requirements are grounded on a discussion of the propositions developed in the theoretical framework and of the empirical findings from the conducted case study research. The requirements will be discussed in two steps. First, the three differentiating activity modules will be discussed, and then the resulting innovation problem solving focus will be derived.

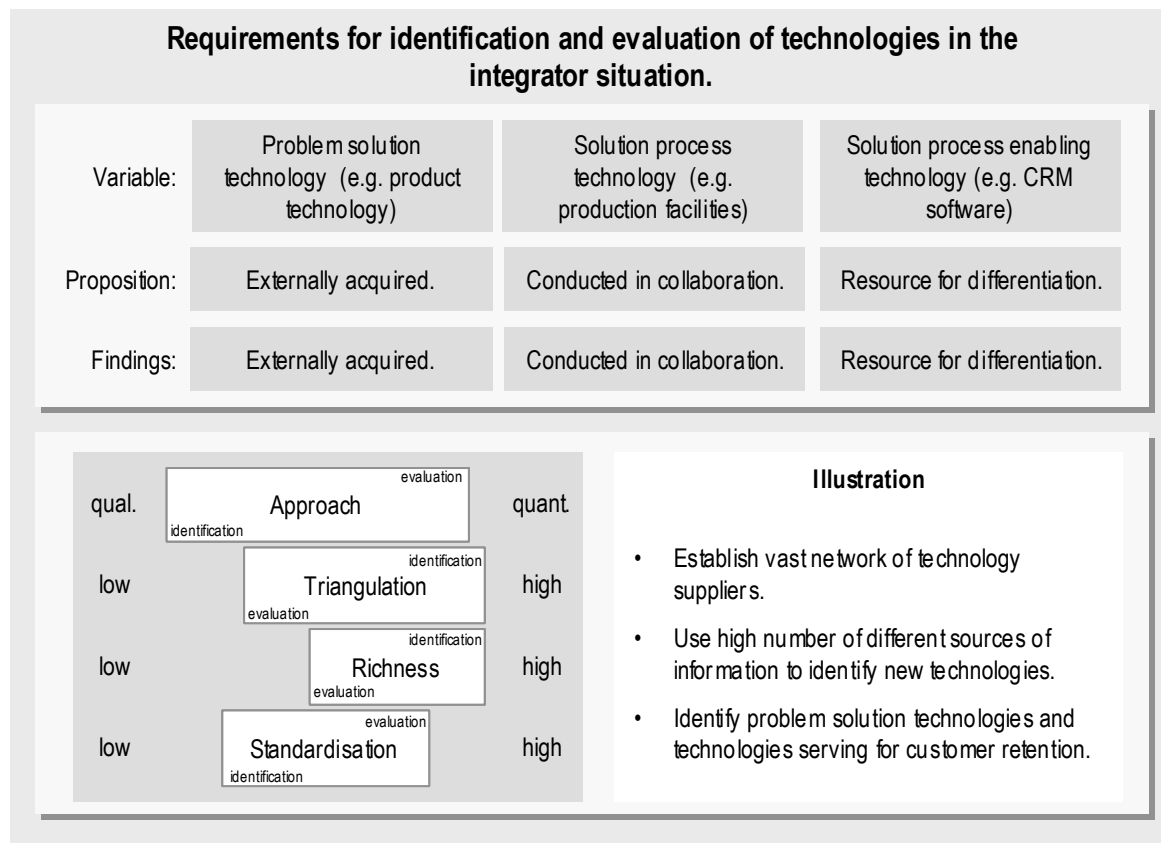
**Requirements for the customer needs and market potential module.**

In this situation, the number of customer need dimensions and their specificity were proposed to be high, and explicability of needs was seen as low (proposition 4.1). In section 6.3.1, it has been explained that in the integrator situation, it depends on the types of problem-solutions that integrators offer. Integrators can be oriented toward close customer relationships, toward mass-products integration, or commodity integration. As a result, the requirements of the respective situations apply here.

**Requirements for the technology and problem-solution module.**

In this situation, problem-solution technologies were supposed to be externally acquired, the solution process was proposed to be conducted in collaboration with suppliers, while enabling technologies are seen as resources for differentiation (proposition 4.2).

In the relevant case studies (cases 9, 11 and 12) it was observed that they were integrating solutions of third parties to their own, existing products. The integrated products can be classified as different problem-solution types themselves. The integrator situation is defined as describing an actor who acquires problem-solutions from the market. Further, case studies were selected to fit to the situation descriptions, and therefore here can be no other observation than the one confirming the proposition. Solution process technology itself is not always necessary in the integrator situation. Here, focus is more on process enabling technology, like logistics and customer relationship supportive technology, or other customer retention measures. From these findings, the following requirements result: The identification of problem-solution technologies is oriented toward the market, and thus here a qualitative, highly triangulated, structured approach is necessary with little formalisation and varying richness of communication. The evaluation of problem-solution technologies follows the defined requirements, and thus should be more quantitative due to the higher number of customers. Therefore, a structured and formalised approach is seen as appropriate. The identification of problem solving process and enabling technologies is proposed to evolve from customer interaction, and thus evolves from a creative problem solving process. As a consequence, the approach here is qualitative, unstructured, less formalised with very rich communication. Evaluation of enabling technologies also follows strategic considerations and thus does not necessarily have to be conducted in a strictly quantitative approach, but as structured and formalised as possible, in close communication.



**Figure 44: Requirements for method selection in the technology module in the integrator situation, developed by the author.**

**Requirements for the competition and collaboration module.**

In this situation, the strongest resource for positioning was assumed to be customer contact and market access. Collaboration partners were integrated on the supply side, and competitors were seen to be found in all types, but especially on the supply side (proposition 4.3).

In all three cases, the outstanding role of customer contact and market access was confirmed, and all relevant case study organisations mainly collaborate with their suppliers. In the relevant cases, the respective organisational situations can be described as being a distribution channel for the suppliers. However, where there are larger suppliers, there is more competitive strength and interest, and thus this has to be described as a partnership. As a result, proposition 4.3 can be regarded as confirmed.

From these findings, the following requirements result: In the case that no contacts to relevant and potential collaboration partners exist, the identification of collaboration partners is oriented towards the market. Thus, a qualitative, highly triangulated, structured approach with varying communication richness is appropriate. The evaluation of collaboration partners has to follow strategic considerations and has to be oriented to the defined requirements. Thus, a mixed approach with quantitative and qualitative elements is necessary. The identification and evaluation of competitors is determined by the integration market type (nearer to close-to-the customer, or nearer to complex mass-product type markets), and to the relationship to suppliers. When suppliers are potential competitors, then the identification goes along with the identification of collaboration partners. When suppliers are not potential competitors, then only direct, substitute, and customer competitors are relevant. Due to the close relationship to customers, the observation of competitors is of importance to find out about additional customer needs. Thus, the evaluation of competitors needs to be more

qualitative than quantitative due to the complexity of customer needs. Here, a highly triangulated, less formalised, structured, and rich communication process is appropriate.

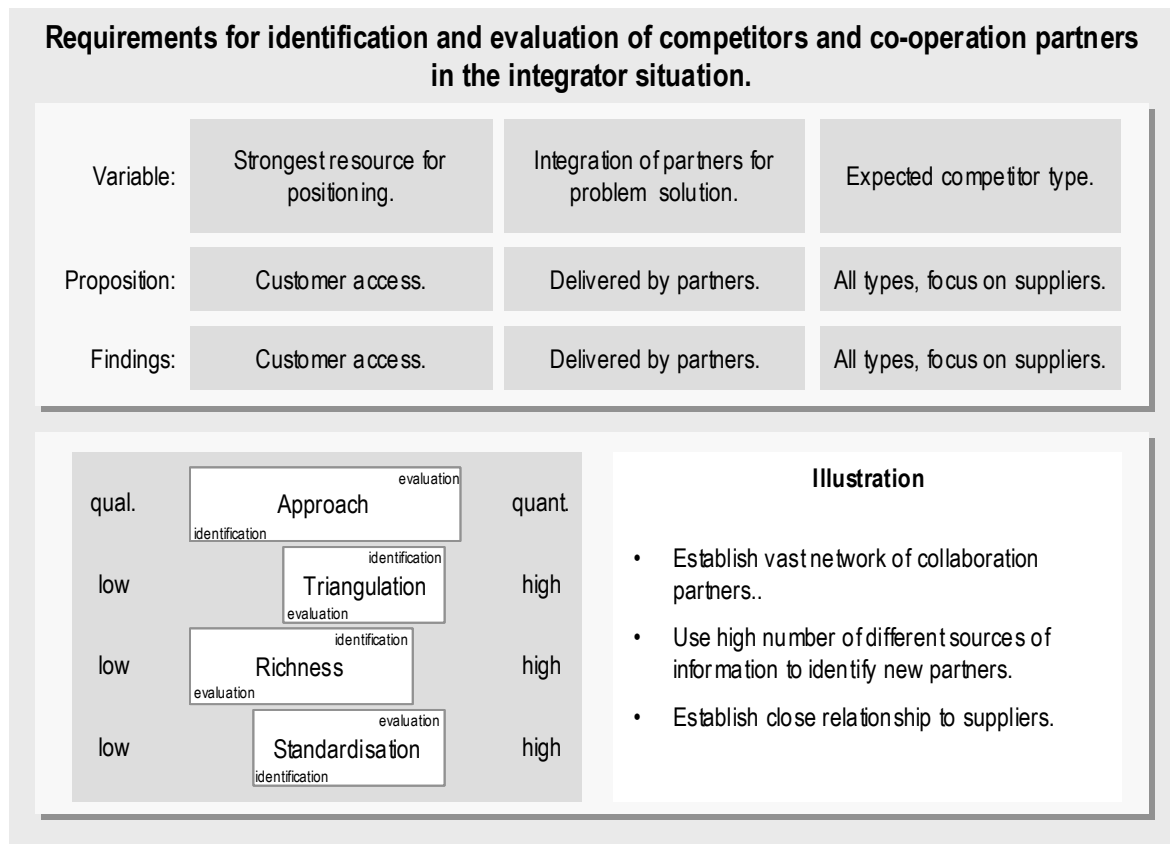


Figure 45: Requirements for method selection in the co-operation and competition module in the integrator situation, developed by the author.

**Resulting innovation problem solving focus in the integrator situation.**

In this hybrid situation, organisations can be in a close-to-the customer situation, or in a complex mass-product situation. However, due to the role of integrating problem-solutions offered by other organisations, competition, collaboration and technology evaluation is determined by this orientation to collaboration. Further, customer relationship and market access are the most important resources for differentiation. As a result, this situation can be described as market and collaboration oriented.

## **6.5 Summary and General Requirements per Activity Module.**

In chapter six, it was the aim to illustrate, evaluate and validate and to apply the theoretical framework as developed in chapter five. In this summarising section, the central findings will be outlined.

In the first step, the case study design has been introduced, which aimed to lead to hypotheses on the basis of the existing theoretical framework. For the reason that hypotheses are the central means to organise and communicate theoretical knowledge, the research design needs to incorporate the factors that define good theory. In order to deliver objective, reliable, relevant and verifiable data, a multiple case design was chosen, consisting of twelve case studies about organisations that can be located in the theoretical framework. In step two, the case studies have been described, in order to provide a basis for discussion in step three. The discussion aimed to address data quality, which comprised in concrete a discussion of situation related findings, methods related findings, and activity modules related findings. Each of the three discussion points ended with a hypothesis that incorporates the central findings of the research. Although not every proposition of the theoretical framework could be confirmed in the same detail, the framework can be considered as a good basis for further elaboration. Thus, in step four, on the basis of the theoretical framework and the basic hypotheses, practical implications and requirements for the appropriate selection of methods have been derived. In the prior sections, the findings have been presented from a situation-related perspective. In this summary, the findings will be presented from an activity module-related perspective.

### **The customer needs and market potential module.**

In the customer needs and market potential module, customer needs are described, understood, evaluated, and aggregated. As a result, a market potential can be estimated and problem-solution requirements can be defined to serve as a basis for technology identification and evaluation, and for the evaluation of investment attractiveness. The tasks in this activity module depend on the number of relevant customer need dimensions, the specificity of need dimensions, and on the explicability of customer needs. In general, it was found that in the early stages of innovation processes, quantitative information about market size is seen as necessary in order to estimate and communicate a market potential. However, a market often is not available at this point of the process. As O'Reilly (1983) has shown, information in organisations is regarded as more trustworthy when it is of quantitative character. As a result, actors start in the early processes with given background market estimates, without making them explicit or validating them, which can also be called an implicit assumption. Only in large organisations, market potential is evaluated explicitly by classic market research and using parallel markets as a basis for estimates. This is also confirmed by research conducted by Trott (2001). As a result, it can be concluded that it is a potential success factor to make as much information about market and need estimates explicit, in order to improve communication in these early stages. For the design of methods, this implies that they need to categorise customer needs in order to make needs and their value explicit and measurable. As a result, in the close-to-the customer situation, this means that here especially complexity of customer needs has to be reduced in order to develop concrete measures that address customer needs. In the commodity situation, methods need to exactly define the expected product features. In the mass product and the integrator situation, the complexity of customer needs has to be reduced and quantified, but also to be understood. Thus, especially here a mixture between qualitative and quantitative methods is necessary.

### **The technology and problem-solution module.**

In the technology and problem-solution module, technologies and principles for customer problem-solutions are identified and evaluated, in order to specify potential problem-solution alternatives and constraints. In this framework, three different types of technologies and problem-solutions are distinguished: customer problem-solution technologies, problem solving process technologies, and enabling technologies. Depending on which technologies are available and appropriate to an organisation and the respective market, the situation has considerable influence on the value and thus on methods for identification and evaluation of changes in technology. In general, in the early stages of innovation problem solving, there is a high degree of ambiguity about technological development, especially in the case of more radical innovations (Trott 1998, Tidd et al 2005). In all conducted case studies it could be seen that technology evaluation took place in parallel to customer needs evaluation, which is also shown in the market-/technology fusion model by Holt (1978, see also chapter two). As a result, methods for the identification and evaluation of technology should always make explicit which customer needs they address in which way, in order to make an appropriate investment decision possible. For the close-to-the customer situation, this implies that technology evaluation should take place with the highest possible involvement of those individuals also involved in customer problem solving processes, in order to assure the transfer of complex knowledge about customer needs. In the commodity situation, technology features need to be evaluated by clearly defined customer needs, and in the mass-product and the integrator situation, technology needs to be concretely tested together with representative samples of the customer population. Further, strategic considerations like technology standards, intellectual property rights, and network effects need to be considered in processes appropriate to the individual market and organisational situation, they are not the subject of the developed framework.

### **The co-operation and competition module.**

In the co-operation and competition activity module, competitors and potential partners are identified and evaluated in order to define the future offered problem-solution. Depending on the strongest resource for positioning, the mode of collaboration concerning the offered problem-solution, and the main competitor type, organisations have to design their methods for identification and evaluation of competitors and collaboration partners. In general, it can be said that in the conducted case studies, organisations rely on personal contact networks of their internal boundary spanners and gatekeepers, which is also confirmed by research conducted by (e.g. Allen, 1977, see also chapter two). In the conducted case studies, it was confirmed by all interviewees, that the observation of competitive activities is an important issue. However, in none of the cases a standardised and structured process of competitive intelligence related to the concrete innovation problem could be found, although they also stated that the identification of problem-solutions offered by competitors can give important insights for their own development process. To summarise, methods for this activity module have to help identify and evaluate potential future collaboration partners and competitors. By making this information explicit, the identification of opportunities and threats can be facilitated. For the close-to-the customer situation, this is especially interesting for the identification of new products to be offered. In the commodity situation, it is helpful to define product specifications and production processes. In the mass-product and integrator situation, new products and strategic technologies identification can be facilitated.

### **The proceeding, feasibility and fit module.**

In chapter five, this module has been introduced as the interface between strategy, organisation and concept development. As an interface, this module includes the process of coming from a strategy to a new problem-solution by co-ordinated activities. Thus, in the proceeding, feasibility and fit module,

### Empirical Validation, Hypotheses, Theoretical and Practical Implications.

it is determined by an individual organisation how to proceed while conducting the three other activity modules. Consequently, this module has to be designed individually to an organisation, its strategy, structure and market situation. This module has not been evaluated related to organisational situations defined by the framework, because it is not as generalisable as the other modules are. However, it serves as the link between the general findings of the research conducted in this project, and organisations who seek to transfer the findings to their individual situations.

In order to make the framework accessible to individual organisations, the three other modules (market, problem-solution, collaboration and competition) have to be addressed in this activity module. Proceedings have been described e.g. by Cooper's (1993) stage-gate process, and the development of innovation strategies has been addressed by Tidd et al (2005), or by Porter (1985). In order to come to novel problem-solution concepts, creativity techniques have been offered by several authors (e.g. Amabile, 1996 or Higgins, 1994). However, in order to develop a concept for an innovative problem-solution that fits to a strategy and that can be implemented by the innovating organisation, the relevant communication and conception processes have to be effectively designed. Feasibility and fit can only be successfully conducted, if there is a process existing that ensures that the developed concepts are evaluated by criteria derived from an organisational strategy, and further if feasibility of a project is evaluated by criteria derived from explicit organisational capabilities and from the other three activity modules. Further, the conception itself has to be supported by appropriate methods, like creativity techniques. In the analysed case studies, the link from strategy to innovation concept generation is not always explicit, as strategy is developed together with future product concepts (see also chapter two). The application of creativity techniques can also be described by the concept of methodological pragmatism, meaning that individuals only apply methods when the demanded results require the application of a certain method. To conclude, methods supporting innovation conception processes need to be as structured as possible, but as flexible as necessary. In order to meet this central requirement for innovation methods, strategy, organisational capabilities and results of the three remaining activity modules need to be made as explicit as possible. However, it has to be ensured by effective communication processes, that the communicated information states can also be changed without a lot of effort in order to avoid the risk of becoming inflexible in the early stages of innovation processes.

The overall research objective is to develop, evaluate and apply theory that explains differences in method selection in different organisational situations. In order to reach this overall objective, objective 3 of this research is to validate the theoretical framework by case study research, to derive hypotheses about the theoretical framework and to develop requirements for method selection in different organisational situations. In this chapter, objective 3 was met. It was shown, that the four situations exist, that the activity modules are comprehensive and that they describe the actual problem in each situation. By the development and discussion of requirements for method selection, it was shown that the proposed method approaches are appropriate. As a result, the overall research objective is reached.



## **7 Summary and Outlook.**

*In this chapter, I will re-capitulate the objectives of the thesis and will clarify the contribution to knowledge. I will summarise the central results of each step of the research and will show how this thesis can lead to further research in the field.*

In the previous chapter, the theoretical framework was evaluated and validated, and hypotheses about the framework were developed. As a result, requirements for methods selection in different organisational situations have been derived and described in detail. In this final chapter, the results of this research will be summarised and linked to the original research objectives. As a result, the contribution to knowledge will be explained and approaches for further research will be shown.

## 7.1 Research Objectives.

An extensive literature review of research on innovation management has shown a gap in existing theory. Existing approaches address the pre-project phase on a strategic or organisational level. The perspective of innovation concept generation has not been sufficiently addressed before. In consequence, the problem of generating an innovation concept has been described (e.g. by Holt, 1978, see chapter two), but the description of methods to support this process either remain on a general level, or are specific to a problem situation. The resolution of an innovation problem is not described in an holistic way and the role of methods to facilitate the process has not been described yet. As a consequence, the recommendations to be derived from existing research are either too generic or not suitable to a specific situation different from the one the methods have been developed for. Existing theory about innovation pre-project problem solving does not provide a structure to allocate and integrate research about methods. Thus, contradictions in recommendations provided by the existing approaches cannot be resolved.

For researchers, this unstructured context for evaluation raises the problem of understanding the pre-project phase in an holistic way. Research on the fuzzy front-end of innovation is very vague and abstract, and recommendations were only to be made on the level of creating an environment for innovation conception but not on explaining how to actually develop an innovation concept (see chapter two for an extensive discussion). Existing research focuses either on more organisational or on more strategic questions. The question of how to approach the problem of innovating from a problem-solving perspective was not researched consistently and sufficiently before.

**The aim of the research was to find out whether there are patterns of conceptual innovation problem-solving in different situations for pre-project processes in order to enable future research to better describe, understand, predict and form the design of pre-project innovation activities.**

Key to the conceptual level of innovation pre-project activities is the perspective of problem-solving, which is a process of collection, processing and communication of information. As a means to support the collection, processing and communication of information, methods facilitate problem-solving processes. Methods selection in pre-project innovation processes were the central research object in this thesis. In conclusion, the central research question was:

***What are the requirements for the selection of methods for information collection, processing and communication in pre-project innovation activities in different organisational situations?***

Based on this central research question, three major research objectives were derived, in order to **develop, evaluate and apply** theory about selection of methods in pre-project innovation processes in different organisational situations:

- Objective 1:** A theoretical framework for the conceptual analysis and description of the fuzzy front-end of innovation processes had to be developed.
- Objective 2:** The theoretical framework, in concrete the concepts of generic situations for innovation problems, activities in pre-project processes, and methods for information collection, processing and communication had to be derived and operationalised, and propositions for their selection had to be derived.
- Objective 3:** The framework and propositions had to be validated by case study research, in order to enable the development of hypotheses about the framework and requirements for method selection.

By meeting the research objectives, this thesis bridges the research gap by providing a theory of method selection for pre-project innovation activities in different organisational situations. In the following section it will be shown, how this research met these objectives.

## 7.2 Summary and Discussion of Results.

The objective of this research was to develop, evaluate and apply theory about the selection of methods in the pre-project innovation phase. It has been shown that methods help to facilitate and support the innovation problem solving process. The innovation problem is determined by an organisational strategy, as innovation is a means to generate future economic or competitive benefits. This implies that the innovation problem is a strategic problem. From this perspective, the selection of methods to support innovation processes can be seen as determined by the strategic situation of an organisation.

### **Objective 1: The contingency view was selected as basic research perspective.**

In order to describe this phenomenon, the contingency approach has been selected in order to distinguish strategic situations that determine the innovation problem which itself determines the methods to be applied. The contingency view has not been left uncriticised, as it lacks a dynamic view and often remains vague about the definition and description of variables (see discussion in chapter 4). However, the contingency view helps to distinguish organisational situations and to derive clear recommendations that can be tested and discussed. Approaches following the contingency view are seen as mid-range theories, because they do not describe basic, generic phenomena but derive conclusions about a clearly defined, limited set of research objects (see discussion in chapters 3 and 4). It has been shown that predominantly contingency research, using the organisational task as the factor determining a situation, are more comprehensive and bear less potential for contradiction than others. The resolution of innovation problems is the organisational task that determines methods selection. Existing research following the contingency view in an innovation context uses for example the position in the value chain or develops industry related contingency factors (see chapter 4, i.e. table 4). The task of problem-solving has not been used as a contingency factor in the innovation context, which might be a reason for the high specificity of existing approaches. By using the task as a contingency factor, the shortcomings of existing approaches can be overcome.

### **Objective 2: A theoretical framework was developed in order to derive research propositions.**

The theoretical framework to distinguish different situations has been derived from theory, because the phenomenon of method selection for innovation problem solving is not observable enough to be explained by observation. Instead, a theoretical framework was developed on the basis of strong, established theory in order to be evaluated and validated at a later stage. The dominant objective for the development of innovation is to raise economic benefit. There are two basic approaches to raise economic benefit. Either the price for a product can be raised, or the costs for production are lowered. As a result, in order to distinguish situations, two dominant and mostly independent dimensions have been selected: the degree of customer problem-solution (which bears the potential to influence product prices) and the degree of collaboration (which bears the potential to influence production costs). The degree of customer problem-solution has been explained by a combined view of Maslow's categorisation of needs, and Meyer's (1996) categorisation of benefits. The collaboration type has been derived from Williamson's (1975, 1985, 1993) transaction cost theory. Both theoretical perspectives have their specific weaknesses, which are not relevant for this research (see discussion

## Summary and Outlook.

in chapter five). However, the approaches lack detailed operationalisability. As a result, the degrees of problem-solution and collaboration can only be described by the values of "high" and "low".

In these four situations, propositions about innovation problem solving focus have been derived. A situation can be understood as a snapshot of an organisation's innovation problem. In consequence, one organisation can be in more situations at a time, depending on the offered customer problem-solutions. A situation and the corresponding problem solving focus is thus determined by a product or service and the way it is generated in a value chain.

The concept of activity modules helps to describe the pre-project phase which is not a linear process, but a summary of interrelated tasks that are conducted in parallel. The activity modules help to describe the tasks conducted in the pre-project phase in the four situations. On this basis, the concept of methods has been operationalised and propositions have been developed. It has been shown that the research object (organisations and their innovation front end activities) is of high complexity. The operationalisation and development of propositions have been conducted with the highest possible accuracy and precision. However, just by describing the phenomenon by appropriate variables and values does not make the research object less ambiguous and complex. As a result, only the specificities or problem solving foci of an organisational situation can be derived. This implies that the tasks are not exclusively conducted in the described way in the respective situations, but can also be found in other situations.

### **Objective 3: The theoretical framework has been evaluated and validated in order to derive hypotheses and requirements.**

The theoretical framework was evaluated and illustrated by case study research. The framework was developed from existing theory, because the described phenomena are not directly observable. Thus, there is the risk of not describing the real world but describing a logical tautology of theoretical constructs. As a result, the case studies had to be selected to fit the defined situations. This bears the risk of validating the theoretical constructs without challenging the quality of the theory. Thus, 12 case studies served to validate the theoretical framework in its three components: the question as to whether the situations distinguish four different categories of innovation problems, the question as to whether the activity modules describe the pre-project phase in a comprehensive way, and as to whether the appropriate method selection bears the potential to increase innovation success. These three evaluation topics have been used to develop hypotheses about the descriptive value of the framework. As a final result, requirements for methods selection in different organisational situations were derived. From the perspective of this research, methods are seen to bear the potential for improving the quality of innovation problem solving, as objective factors for the determination of method selection have been analysed. However, it was shown that problem solving and decision making processes are subject to human cognitive processes which are limited by satisficing behaviour and other personal and organisational factors. Thus, method selection cannot be completely determined by fully rational considerations. In consequence, it will remain individual to organisations to develop their own mix of appropriate methods for the pre-project innovation process. However, knowing the individual innovation focus will facilitate their definition and selection for application. As a result, this research can only outline approaches to the potential improvement of innovation pre-project processes, and the confirmation of the theory has to consider these limitations.

### **Meeting the research aim: The result is a mid-range theory about method selection in different organisational situations.**

The central aim of this research was to identify patterns for method selection in pre-project activities. By the development of a mid-range theory, these patterns can be identified, described and predicted.

Following the contingency approach and delivering a consistent and comprehensive set of variables, propositions and hypotheses about a limited set of phenomena, the result of this thesis can be described as a mid-range theory (see discussion in chapter three). The research approach was basic in the sense that the aim was to enable further research on the concept oriented level of pre-project innovation processes. Further, the research is of an applied nature, as it provides a framework of propositions and requirements for method selection. Thus a basis for managerial intervention is delivered. A theory has to be falsifiable and of interest and utility (Bacharach, 1989; Weick, 1989). A central purpose of theory is the organisation and communication of knowledge among researchers. In order to meet this purpose, a theory has to meet several quality criteria: objectivity and reliability; relevance, generalisability and significance; comprehensiveness, consistency and precision; validity and verification (see chapter three). The following table summarises, how the criteria for the quality of theory development have been met.

<p><b>Objectivity and Reliability</b></p>	<ul style="list-style-type: none"> <li>• All sources of literature are made overt and the relevant sources were used as a basis for the research.</li> <li>• All conclusions were explained traceably, the preconditions and constraints for conclusions were explained.</li> <li>• The framework was operationalised in detail and each variable was derived from traceable sources.</li> </ul>
<p><b>Relevance, Generalisability and Significance</b></p>	<ul style="list-style-type: none"> <li>• The overall relevance and benefit of the research topic were explained, and its relevance to the research objects was discussed.</li> <li>• The relevant terminology was defined and its relevance was discussed.</li> <li>• Due to the theoretical grounding and the case study approach, analytical generalisability is given.</li> <li>• Significance of the research results has to be evaluated in a quantitative study.</li> </ul>
<p><b>Comprehensiveness, Consistency and Precision</b></p>	<ul style="list-style-type: none"> <li>• The research is comprehensive, as all the relevant issues and variables have been addressed and included or excluded from the research.</li> <li>• The limitations of the research were discussed.</li> <li>• The selected variables and constructs were all derived from a basis of clear and comprehensive discussion.</li> <li>• The variables and constructs were operationalised precisely and their interrelations were discussed and operationalised.</li> </ul>
<p><b>Validity and Verification</b></p>	<ul style="list-style-type: none"> <li>• The theoretical framework was derived from a basis of relevant and established theory.</li> <li>• The framework was pre-tested, evaluated and validated on the basis of 12 case studies.</li> </ul>

Table 12: Evaluation of criteria for quality of theory development.

### 7.3 Contribution to Knowledge.

In chapter one, the following key contribution to knowledge has been introduced:

**To enable future research to better describe, understand, predict and form the design of pre-project innovation activities by developing patterns of conceptual innovation problem-solving in different organisational situations.**

Innovation pre-project activities (and innovation activities in general) have not been researched in a holistic way before. With this thesis, theory has been developed within this new research field. Propositions and requirements for method selection were developed. They serve as a means to compare different organisations and their requirements for methods in the innovation pre-project phase, and to resolve contradictory recommendations derived from existing research. Thus, the central contribution to knowledge delivered by this thesis is a mid-range theory that explains different method requirements. In consequence, approaching the innovation pre-project phase on a conceptual level thus is a new research problem. As a result, a specific proceeding to develop theory was developed and applied.

Before this research was conducted, there was no approach to explain the role of methods for innovation pre-project activities as supporting the process of information collection, processing and communication. There are however definitions and sets of methods for specific innovation-related problems that have led to heterogenous research results. This research provides a comprehensive and useful definition of methods and thus allows a further investigation of the phenomenon. As stated in chapter one, taking the conceptual perspective on pre-project activities is a key contribution in order to integrate existing and future research approaches.

The contingency view has been widely applied in the innovation context (see table 4). However, the concept oriented level has not been approached before. Using the task of innovation problem solving as contingency factor allows a more comprehensive and consistent categorisation and thus a distinction of situations independent from organisational size, industry or innovation type. As introduced in chapter one, the distinction of organisational situations and resulting innovation problem-solving foci results in a contribution to knowledge.

Several research approaches have described the pre-project phase or the so-called fuzzy front-end of innovation (see chapter two). However, the existing approaches have not been suitable to compare innovation pre-project activities in different organisations. They have only described the phenomenon as such on a general level. The concept of activity modules allows a process-independent approach to compare innovation problem-solution activities in different organisations. Further, they can be applied to design the task organisation on a company level. As stated in chapter one, this research provides a structure and clear understanding of pre-project activities, and further an operationalisation of the key concepts. This contribution allows to analyse, describe and compare the pre-project phase in different organisations.

In conclusion, this research helps to categorise and evaluate existing research, and to direct future research about methods for innovation pre-project problem solving activities. By applying the theory, a new research field can be better explored in future.

## 7.4 Further Research.

This new theory allows further research to be conducted. In this thesis, the theory has been operationalised, evaluated and validated by case study research. In the next step, a quantitative study should be conducted in order to validate the propositions and hypotheses with a larger sample and quantitative measures. A quantitative study allows a more detailed evaluation than is possible with a qualitative research approach, and statistical generalisability and significance can be tested. This way, the findings of the research can be further confirmed or falsified.

The theory helps to organise and evaluate existing research about innovation methods. By the distinction of requirements for different organisational situations, existing methods can be evaluated about their fit to specific situations. In the next step, further research can apply the theory to allocate and evaluate methods for different organisational situations and identify gaps about method development for different organisational situations. This way, new methods can be developed in a systematic way and thus research can contribute to improve innovation processes in organisations.

With the theoretical framework, a way to evaluate organisations has been developed. By applying the theory, researchers can compare organisations and understand similarities within and between organisational situations. Best practices can be transferred from one organisation to another and in consequence, future method development can be improved. Further, this has also a practical impact, as organisations are able to learn from other organisations, to design their pre-project activities according to their individual situation, and can prepare their processes prior to a change of their situation.

This theory focuses on objective factors determining the requirements for method selection for pre-project problem solving. However, personal and organisational factors are out of the scope of this research. For future research, it would be interesting to compare findings focused on personal or organisational factors, in order to increase the precision of predictions and recommendations for a specific organisation. To reach this objective, either the existing framework needs to be extended, or a new contingency model using organisational or personal attributes as contingency factors needs to be developed and related to the framework developed in this thesis.

This research is focused on the conceptual level of pre-project processes. At the end of chapter two (figure 9), it was shown that strategy, innovation concept and organisation interrelate and constrain each other. Innovation concepts are developed to reach strategic objectives (see chapter two), and thus strategic measures like market entry barriers (e.g. intellectual property rights, network effects, industry standards) are used to design innovation concepts (e.g. Porter, 1982 and 1985). As a result, innovation strategy and innovation concept generation are conducted in parallel and cannot be entirely separated from each other. Due to high industry specificity of strategic factors, they have been out of the scope of this research. Thus, the description of pre-project activities is not entirely complete in this research, because the link to a strategy cannot be completely covered on this general level. As a result, in the next step, the theory needs to be extended by these factors and applied to specific industries in order to find out whether the requirements differ in a specific industry context.





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## **Appendix 1: Case Studies.**

In this section, each case study organisation will be briefly described, and the product type will be explained and positioned in the context of the theoretical framework. In the second step, the case will be described along the activity modules of customer needs and market potential; technology and problem-solution; co-operation and competition; and proceeding, fit and feasibility. In the third step, the implications for the respective situations will be explained.

### **Case 1: CO<sub>2</sub> emissions trading -consulting close to the client.**

Case study 1 provides legal and business consulting services in the field of emission certificate trading to various clients from various industries. With its 20 employees, case 1 supports their clients with the implementation of organisational routines, processes and technologies that help organisations to adapt to a new legal environment. Case 1 works very closely with their clients, and basically works without collaboration partners in the first step. When specific problem-solutions for clients become necessary, case 1 contacts their pool of collaboration partners, but remains as the supervising single point of contact to the client. Case 1 is part of a think tank which is identifying and developing new business concepts in order to found new companies and grow with the shares of these spin-offs. The think tank explicitly mentions their method competence and background, and thus this organisation was regarded as a promising case study organisation. The case study data was taken from a semi-structured interview with a senior project manager who is also part of the extended company management. Press releases, web site, and company brochures also served as a basis for data collection.

#### **The customer needs and market potential module in case 1.**

The clients' problems result from the implementation of the Kyoto protocol for the reduction of greenhouse gas emissions. In the European Community, a trading system will be introduced that forces companies from all industries to reduce their emissions. In order to control emissions, emission allowances will be given out. Organisations who emit less greenhouse gases than allowed by their certificates can trade their spare certificates with organisations who exceed their allowance. Currently organisations do not know how to measure, to monitor and to reduce their emissions. They also need assistance with the new trading system.

The basic problem is similar for all case 1 clients, but the implementation of the new system is highly individual because of the individual organisational circumstances. Further, different legal interpretations and bases for emission measurement make the trading of certificates at the beginning of their introduction ambiguous to a certain degree. In addition, the reduction of greenhouse gas emission is a highly specific problem due to different organisational circumstances. The explicability of problems is given. However it is highly complex and thus the problem solving process requires a project oriented problem solving process.

In the given and explicit legal context, case 1 evaluates the individual client needs closely with them. The legal context is monitored in a structured and systematic way, but processes are formalised to a low degree. Every consultant observes the news and magazines. Further, case 1 is involved in the institution that is responsible for the introduction of the trading system in their country. At the beginning of a client project, the specific clients' needs are evaluated in a standardised way using workshops. The evaluation process is standardised in order to manage and evaluate the high



complexity. As the customer needs become more explicit in the course of a project and thus the structure that is necessary at the beginning loses importance, a new structure evolves. As a result, case 1 works mostly with different sources from within the clients' organisations and compares the identified needs with needs identified in prior projects with similar clients. The needs identification routine is standardised, but is open to new results. Rich face-to-face communication and learning from previous projects are key to understanding and evaluating clients' needs. In order to test a new concept, a small team works out a new problem-solution, which is offered to the clients. The new concepts evolve from previous projects or from other sources. The evaluation of these new concepts is conducted along similar lines to previous projects.

### **The technology and problem-solution module in case 1.**

The problem-solution provided by case 1 is mostly of a non-technical nature. Knowledge about the legal situation, knowledge about the clients' business, and knowledge about possible technical problem-solutions enable case 1 to solve their clients' problems. Technology and problem solving routines are necessary for identifying and monitoring emissions, for reducing emissions, and for evaluating the value of emission certificates. Identification and monitoring of emissions can be managed by partially standardised databases, which are adapted to the specific clients' requirements. Technologies for reducing emissions are supporting elements for the whole problem-solution, and they are specific to industries and client organisations. The value of certificates is determined by market structures, and thus the process enabling technologies are determined by external structures.

Case 1 develops their own structure for evaluation and client problem solving. This problem solving process grows and develops with every new project. The semi-structured database templates are based on externally developed solutions, and thus technology is externally acquired. Further, technologies for the reduction of greenhouse gas emissions are acquired or being mediated by case 1. As a result, the sources for technology information are oriented towards the market, and acquired in the case of necessity. The information collection process can be described as partially standardised, information media of lower richness are appropriate in the first step. In the second step, the approach to the evaluation of technologies depends on the specific situation, it can be more qualitative or quantitative. In the context of emissions trading, most of the success criteria can be quantified, therefore a more quantitative approach is regarded as appropriate.

### **The co-operation and competition module in case 1.**

The strongest resources for case 1 are the close relationships to their clients, and the extensive knowledge about the legal and business environment of emissions trading. As a result, only large client organisations could be in the position to also build up the same competence about emissions trading. Direct competitors are of high importance, especially when they also have relationships with the same clients. However, the identification and evaluation of competitors plays a less important role for case 1.

The identification of collaboration partners is as aforementioned focused on delivering technology that serves to solve the problems of reducing greenhouse gas emissions. These are identified and evaluated case and project specifically, which is conducted in a less standardised way.

### **The proceeding, fit, and feasibility module in case 1.**

In case 1, the proceeding for coming to a new solution concept can be described as a successive concept development. The basic frame for concept development is the legal situation, which can be

anticipated and thus acts as a means to also anticipate customer needs. The individual customer needs are developed from current and prior projects and thus can be partially anticipated. These customer needs are implicitly known by the consultants and thus are assumed as partially generalisable. The importance of methods for innovation concept generation is not as high as assumed, for example creativity techniques or methods for concept evaluation are only used, if uncertainty and ambiguity are too high to solve a problem without method support. In order to evaluate the feasibility of a new concept that has evolved from day to day work, the potential effort is evaluated, and the solution will be offered to a client in a concrete project. This pilot project serves as a means for concept evaluation. The strategic fit is evaluated in parallel to the concept development, as the organisational strategy, competences and resources are familiar to most of the members of the organisation. Close collaboration of the team enables a quick and informal matching of available resources and the new concept.

### **Case 2: Knowledge management solutions- close-to-the customer product and service combinations.**

The analysed case study organisation provides knowledge management solutions to all kinds of organisations of a certain size. With its 250 employees, case 2 supports their clients with software helping to identify knowledge and competence within an organisation. One core product is a software that identifies patterns in existing data bases. Case 2 works in close relation with their clients in order to implement their semi standardised software solutions. The customising of self-developed software solutions makes case 2 a problem-solution provider who delivers close-to-the-customer problem-solutions at the same time as complex mass-products. There is not much collaboration with external partners, only for clearly defined sub-tasks which require specific technological competence. The organisation is well known for its participation in funded research projects about method development and thus, there is high method competence to be expected. The case study data was taken from a semi-structured interview with a senior product manager who is responsible for development, implementation and internal co-ordination of client projects. At case 2, there is no specific innovation management department. Further, press releases, company web site, and company brochures served as a basis for data collection.

#### **The customer needs and market potential module in case 2.**

Case 2 offers specific search engines for content and knowledge management that can be integrated in any IT system of their clients. As a result, they offer information logistics systems which raise efficiency and effectiveness of business processes. As business processes are relatively complex and specific to an organisation, the number of need dimensions of clients is high. The application of the search engines can be in different contexts and for many purposes, in many different IT systems, which can meet the relatively high specificity of customer needs. The needs of clients are determined by the needs of users who apply the search engines and collaboration software. As a result, case 2 receives problem descriptions for the required solutions, which however remain vague about the detailed solution.

The approach to client need identification can be described as a definition process, which is conducted by a product manager. Further, new client needs are identified within projects in order to further develop existing solutions and re-offer them to the market. The identification of customer needs focuses on the customers themselves and on the relationship with the customers. Triangulation takes place in the form of re-offering solutions from prior projects to other clients. The richness of communication media is high, because needs are identified in the course of running projects together with clients. The communication process is standardised in the form of a

proceeding like a sequence for the conduction of workshops, but not in the form of standardised information collection media.

### **The technology and problem-solution module in case 2.**

The problem-solution offered by case 2 is software for content and knowledge management. The problem-solution is technology itself, which is further developed and implemented in processes in the course of client projects. The technology development process is supported by standard communication and development platforms, in this special case also by the offered problem-solution. Thus, this case example is not representative, because in other organisations in the same situation an acquisition from the market could be expected. Process enabling technology does not play a role in this case.

In case 2, technology development is a co-ordinated process in the course of a client problem-solution project. The solution evolved from a university research project and was steadily further developed in the course of client projects. Triangulation takes place in the terms that different application contexts make the problem solving technology applicable in different contexts. The identification and evaluation of problem-solutions for technology enhancement takes place in a structured, but not standardised way within and apart from projects. Technology managers scan the available information sources for further technical possibilities. Richness of media is limited, as mostly publications or trade fairs are used to identify new technology. The evaluation process takes place in concrete projects.

### **The co-operation and competition module in case 2.**

The strongest resource for collaboration is the relationship and direct contact to clients, and the good knowledge about customer needs and technological possibilities. Competitors are mainly direct customers, because the offered problem-solution is very specific. In this market, there are oligopolistic structures. Collaboration with partners is limited to clearly defined subtasks in software development. Contractors are identified in a structured but informal way. The evaluation of contractors is conducted along clearly defined criteria. Competitors are identified via clients and their IT departments, at trade fairs and at client offering processes. Competitors are evaluated predominantly about the quality of their delivered problem-solutions. Analysis of competitors takes place in an unstructured way in order to identify new potential problem-solutions. Here, potentially every information source is relevant, but they are not used in a formalised or standardised way. Richness of applied media is generally higher.

### **The proceeding, fit, and feasibility module in case 2.**

The proceeding in order to develop new solution concepts is defined by current client projects. The organisational fit criteria lean on the strategy, although at case 2, there is a bottom-up strategy approach, which implies that new solutions are proposed and then it will be decided, whether there is strategic potential. The feasibility of new solutions evolves from existing projects, or in the case of externally identified new solutions, new solutions are observed for a certain, undefined period until they can be regarded as settled. In case 2, predominantly rich media are used.

### **Case 3: Architectural planning and project management -a close-to-the customer service.**

The analysed case study organisation provides architectural conception, planning and project management services to all kinds clients. With its 3 employees, case 3 supports their clients with the planning and project management of buildings for private and business clients. Case 3 works in very close relation with their clients in order to develop their service and deliver complete problem-solutions in the form of built environment. The conception, planning and project management services make case 3 a problem-solution provider who delivers close to the customer problem-solutions and solves customer problems to a very high degree. As case 3 delivers complete buildings and they only provide planning and management services, they need to collaborate with external partners, predominantly with construction companies and specialised planners. However, they only collaborate for very clearly defined subtasks and keep their partners under supervision. This makes case 3 an organisation which can be classified as a close-to-the customer problem-solution supplier, close to the integrator situation. The organisation is highly committed to its methods development, which makes them a competent partner for a discussion about methods. The case study data was taken from a semi-structured group interview with the managing partners. Further, press releases, company web site, and company brochures served as a basis for data collection.

#### **The customer needs and market potential module in case 3.**

Customer needs are highly specific, the delivered problem-solution has to address various application contexts, as buildings have to serve for representation and have various functionalities. A building is a problem-solution for a longer period and thus future needs of clients have to be anticipated. In consequence, the number of customer need dimensions is high due to the high number of applications. The specificity of customer needs is relatively high, too, although problem-solutions can be standardised to a certain degree. The explicability of customer needs is relatively low, because future needs have to be anticipated.

In order to define customer needs, there is only one single source really important: the customers themselves. Due to the close relationship and the high degree of collaboration with clients, rich media are used to define customer needs with a standardised evaluation scheme, that leaves space for evaluation. Thus, the evaluation of customer needs is partially standardised and little formalised.

#### **The technology and problem-solution module in case 3.**

Technology is an important part of the complete problem-solution, although not provided by case 3. The planning is conducted with supporting technology. The problem-solution itself is a building concept. Single, partial problem-solutions are learned from previous projects, which includes predominantly specific room concepts. Process technology is like problem-solution technology provided by collaboration partners. Process enabling technology (like project management software) plays a role to supervise and keep track of collaboration partners. Here, also routines or rules for interaction play a major role.

In order to identify technology, there is an orientation toward the market to be identified. Market screening, is followed by qualitative and quantitative evaluation techniques that depend on a later application of the technology (e.g. door handles are evaluated differently than insulation technologies). Identification and evaluation are conducted with communication media of limited richness, catalogues and product brochures are used, for example. The quality of delivered technology is checked in client projects, and reused in future projects in the case of high potential for

problem resolution. Similar to case 1, here a learn and reuse approach can be identified. The identification and evaluation of technologies is structured, but not formalised or standardised.

### **The co-operation and competition module in case 3.**

The strongest resource for collaboration is the close relationship and deep knowledge about customer needs, especially the knowledge about restrictions is important. In the phase before contracting with clients, mainly direct competitors are relevant, in the case clients ask for competing offers. Competitors and especially their buildings are used to learn for future problem-solutions. Collaboration takes place predominantly with executing organisations, here identification and evaluation take place mostly qualitative. What counts is the whole impression a new collaboration partner makes. After a project completion, partners are evaluated and a decision is made as to whether the collaboration partner will be asked to be integrated in future projects or not. Triangulation of information sources is relatively low, important for the identification of competitors are the chamber and contests, for collaboration partners, mainly local suppliers are evaluated. Richness of communication is high, processes are little formalised and standardised.

### **The proceeding, fit, and feasibility module in case 3.**

Methods evolve in the course of problem solving, they are used for structured communication in the complex field. Feasibility can be evaluated in the course of needs evaluation and planning, mainly in running client projects. Strategic fit is analysed before a contract is signed. New concepts are developed in the course of projects, the re-use is decided in the conception phase of the next project.

## **Case 4: Carbon nano fibre material -a high-tech commodity.**

The analysed case study organisation provides specialised material, carbon nano fibre material mainly to commodity and mass-product producers. The material can be used as additive for polymers, as catalyst for fuel cells, and for several other applications. With its 4 employees, case 4 delivers raw material at a high quality. Case 4 works in very close relation with their clients in order to define product specifications. When the product features are once specified, focus is on supplying the material at a defined price and quality. This makes case 4 a commodity solution provider, who does not solve a complete customer problem, but only a defined part of the problem, the supply of raw material. Case 4 do not work with collaboration partners. As a result, they can be classified as a commodity supplier. Case 4 belongs to the same think tank as case 1, who communicate their high commitment to innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the managing director, who is also technology development specialist. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 4.**

The customer problems are limited to clear specifications and the processes of the customers. Thus, the number of need dimensions and specificity of needs are low and the explicability of needs is high, because it is measurable by quantitative criteria.

The identification of needs takes place in a two-step process: first, customer needs are identified in the scientific community in order to find industrial applications for the material. Once defined, these applications are presented to potential future customers, who act as lead clients to help define

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specific needs in close collaboration. The number of potential clients and the resulting market potential has been evaluated before the lead clients are selected. Thus, this process can be described as an iterative learning process. As a consequence, there is little triangulation of sources, and highly rich communication media to be found. Processes are not standardised, however partially formal due to the procurement organisations of clients.

### **The technology and problem-solution module in case 4.**

The delivered problem-solution is the produced material, its features are evaluated in laboratories, and its applications can be identified in scientific journals, magazines, trade fairs and conferences. Problem solving process technology plays a major role in this case, as the material is new and especially production technology is not fully developed yet. Thus, production technology is the central means for delivering the problem-solution. Solution process enabling technology does not play an important role at case 4.

In order to evaluate technology, quantitative methods are used to test whether the defined specifications can be met. The identification of technology features is highly structured, but not standardised or formalised. In order to test the quality of the produced material, there is a highly standardised process. For the identification of technology applications, a broad range of information sources is used, for the evaluation only the trial can be a reliable information source. As a result, the richness of communication, formalisation and standardisation of processes are mixed.

### **The co-operation and competition module in case 4.**

The strongest resource in this case is production technology and high competence about the features of the produced material. Mainly direct competitors act on this market, who develop similar production technologies. As the applications are technology driven, competitors are an important source to identify new applications for the technology. Collaboration only takes place with customers in order to specify product features.

The identification of competitors is supported by several information sources like trade fairs, scientific publications and press releases are used. Clients are also an important source. As a result, richness of communication media is high for the identification of partners and competitors, but the evaluation can take place with less rich methods. Identification processes are less formalised and standardised, but show high structuredness in the evaluation phase.

### **The proceeding, fit, and feasibility module in case 4.**

At the beginning, the necessity for a new technology was identified with the development of fuel cell technologies. The storage of hydrogen was a problem to be solved by technology. The features were known and thus it was started to test and develop the new material and production technology. Over the time, further potential applications were identified. The proceeding thus was an interactive process in parallel to technology development. Feasibility of application was tested in the laboratory and feasibility of production technology was evaluated in technology development. The strategic fit was not comparable to other cases here, because the development started in a multinational enterprise, where fuel cell technology and hydrogen storage had to be identified as strategically important or not. Thus, the whole development project was a feasibility and fit project. Interesting is that the methods for identification and evaluation of information have developed over time, and have not been explicitly implemented, but have always been present. An explicitness of methods was not seen as necessary.

### **Case 5: Perforated metal sheets- a design and function commodity.**

The analysed case study organisation provides standardised perforated metal sheets mainly to craft workers, dealers and mass-producers. The sheets are applied as screens or in functional applications. With its 200 employees, case 5 delivers semi-finished parts for further processing. Case 5 works mainly with collaboration partners to develop production technology, and in loose relationship with clients for product specification. Case 5 focus on supply within 24 hours. This makes case 5 a commodity solution provider, who does not solve a complete customer problem, but only a defined part of the problem, the supply of semi-finished parts. Case 5 communicate their high commitment to innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the a member of the supervisory board, who has been the former technology development specialist and managing director. Further, press releases, company web site, and company brochures served as a basis for data collection.

#### **The customer needs and market potential module in case 5.**

Customers use the perforated sheets to manufacture specific design or functional elements for individual clients. They can define clear specifications for the metal type, its thickness, and the composition and form of perforations. The number of need dimensions is very limited, quality, availability and price are the most important criteria. As a result, the specificity of needs is low and the explicability of needs is high.

In order to identify new customer needs, the sales department collects requests than cannot be satisfied. On this basis, the technical requirements for production technology are defined. Further, the search for additional applications of perforated sheets is an ongoing process. For existing clients, the number of sources is limited, communication is structured and formalised. However, the identification of further applications is a highly triangulated process. Many sources are used in an unstructured, rich and little formalised way. At case 5, when customers ask for certain product type, this is not quantitatively evaluated.

#### **The technology and problem-solution module in case 5.**

The problem-solution is a perforated metal sheet, which will be further processed, and thus it is not of a technological kind. In this case, problem solving process technology is an important factor, as it defines the limits of product quality, availability and price. Solution process enabling technology is not relevant here.

The approach for identifying new technological possibilities is triggered by unsatisfied requests. Technology development takes place together with facility suppliers which are identified on trade fairs in this oligopolistic market. Together with suppliers, the capacity and special features of the existing facilities are extended. For identification of technology, triangulation is not important, and for evaluation neither. At case 5 this is a team problem solving process, and thus communication is rich, and of limited formalisation and standardisation. The evaluation of new technology is only possible ex post, which is mainly a quantitative process along set criteria.

#### **The co-operation and competition module in case 5.**

The strongest resource in this case are the existing production facilities. Competitors are predominantly of a direct kind, and further clients who have a certain size. As shown above,

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collaboration takes place mainly with suppliers who are also in an oligopolistic market. Thus, identification of partners plays a less important role and is more qualitative, the evaluation is mainly qualitative because the way and organisation of collaboration is an important factor.

To identify and evaluate competitors, triangulation of sources is not very important, as they can be met at the industry association and at trade fairs. Information about competitors is used to identify new production technology and additional applications of the product. Richness of communication is high, processes are little formalised and standardised.

### **The proceeding, fit, and feasibility module in case 5.**

The strategic fit is already identified with a new, unsatisfied customer request. Because new applications of the product are identified in an ongoing process, the search is already guided by defined criteria: production volume and feasibility for production and sales. Technical feasibility is checked in the course of collaboration projects. Methods play a less important role here, they are only applied implicitly, or cost and performance related.

### **Case 6: Punching and bending parts- a functional commodity.**

The analysed case study organisation provides standardised punching and bending parts mainly to suppliers in the automotive industry. The parts are applied as parts of electronic fuses, for example. With its 25 employees, case 6 delivers semi-finished parts for further processing. Case 6 works mainly with collaboration partners to develop production technology, and in close relationship with clients for product specification. This makes case 6 a commodity solution provider, who does not solve a complete customer problem, but only a defined part of the problem, the supply of semi-finished parts. Case 6 are known for their interest in innovation methods which they show by the participation in several funded research projects, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured group interview with the two managing directors, who are also responsible for innovation management and new business development. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 6.**

Customers need punching and bending parts for the production of complex mass products, like fuses or anti block brake systems. The clients clearly specify their needs and state clear product definitions. A product request is normally specified by CAD data. Thus, on the one hand the products are specific, but due to the flexible production system, the specificity of customer needs is not a criterion for differentiation. The need dimensions and application contexts are limited to the specified product application. As a result, explicability of customer needs is very high.

Customer needs are identified by clear product specifications, information and communication can be limited to standardised media with high structuredness, like CAD data or technical sketches. Sources for the identification and evaluation of customer needs are the customers themselves. Rich communication is only necessary in the case of more complicated requests. The future needs of customers can only be identified indirectly, because product development and research takes place at the clients' site.



### **The technology and problem-solution module in case 6.**

The clients' problem-solution is clearly defined by the clients, the outcome is not of technical nature, but an artefact. As a result, problem-solution technology is of less importance than problem-solution process technology. For every charge, the production tools have to be developed. Process enabling technology does not play a role in this case.

The identification of new production technology (punching and bending tools) is a creative process of developing a new tool. Further, production technology suppliers deliver new technology. These can be identified at trade fairs, or by direct contact. Thus, in this special case triangulation is of less importance, but richness of communication media plays a very important role in these semi-standardised, unformalised processes.

### **The co-operation and competition module in case 6.**

The strongest resource in case 6 is production technology, in this market mainly direct competitors play a role. Collaboration only takes place with customers for product specification.

The identification of competitors mainly takes place at the client's site, at trade fairs or at the regional industry association. Further collaboration partners are not relevant in this case. As all relevant competitors are known, methods for their identification play a minor role. It is of high interest to find out how competitors organise their production facilities and which additional products they offer, in order to also identify new business areas. Richness of communication is high. The most frequented information sources are personal contacts, which can be accessed by rich, less structured and standardised communication methods.

### **The proceeding, fit, and feasibility module in case 6.**

As customer needs are defined at the first product request, an evaluation of organisational fit and technical feasibility is part of every production process. When new applications of punching and bending parts are identified, a similar process would start as with existing customers. For this reason, fit and feasibility are essential parts of day to day business.

## **Case 7: Special glass components -from commodity to complex mass products.**

The analysed case study organisation provides special glass components for industrial applications. The glass is applied for TV screens, optical lenses, or for tools in laboratories and medical applications. With its worldwide 17.200 employees, case 7 delivers complex high-tech semi-finished parts and components for further processing and for direct application. Case 7 works mainly in collaboration with internal and external partners, like customers and co-operation partners to gain market access. This makes case 7 an organisation in between the two situations of commodity solution provision and complex mass-product supply, who predominantly solves only a defined part of the customers' problems, the supply of semi-finished parts. Case 7 regularly arrange conferences, benchmarking discussion forums, and they publish regularly their newest method knowledge. This makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the head of New Business Development, who are responsible for the facilitation of innovation projects. The department is part of corporate functions, corporate innovation and technology monitoring. He takes responsibility for idea generation, selection, business planning, and implementation. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 7.**

In this technology focused industry, customer needs are implicitly or explicitly existing. Need dimensions are multi faceted, as in this business to business relationship industry, customers strongly depend on their own customers. The number of need dimensions is high, but needs are mostly of technical and thus measurable kind. However, explicability of needs is partially low, because technical benefits are often only of indirect benefit, and the total benefit has to be measured by the clients of the clients.

The identification of needs is conducted qualitatively and quantitatively, in the form of focus groups, which are small, representative groups of existing and potential clients. The identification of clients is highly structured, evaluation of customer needs is more qualitative in the early stages.

The quantification of market potential is seen as given, and before idea generation not explicitly analysed, while single clients are seen as representative. As a result, there no high triangulation. In the first step qualitative evaluation, in the second step quantitative, calculatory evaluation.

Richness of communication media is high in the first step, in the second step there is only little communication with clients. The proceeding is little formalised and standardised, however very structured.

### **The technology and problem-solution module in case 7.**

The problem-solutions are materials or components, thus technology plays an important role for problem-solution and for processes. In this case product technology is the driver for all other activities. However, technology competence is around specialised glass products, and thus technologies are centred around the existing facilities and knowledge about production technology. As a result, knowledge about solution processes is an important factor in this case. Process enabling technology does not play a major role at case 7.

Applications of the product technology are identified and evaluated in basic and applied research laboratories, in a highly systematic and structured approach. In addition, the scientific community is used to gain further insights and potential applications of the materials. Triangulation is high for identification and evaluation of technology, technology is evaluated mainly quantitatively, but also in a qualitative way. Richness of communication media is high, due to the work in laboratories. The identification and predominantly the evaluation of technology is conducted in a highly structured and formalised process.

### **The co-operation and competition module in case 7.**

For case 7, the strongest resource is product and production technology, while market access is the strongest constraint. Predominantly direct competitors and producers of substitution material are to be found. Collaboration takes place mainly with suppliers and clients in the supply chain, and with other partners to gain market access.

In order to identify and evaluate partners for collaboration, qualitative and quantitative methods are applied. However, predominantly a trial can deliver the best information about partners, which is evaluated by multiple information sources, highly structured, but little formalised and standardised. Information about collaboration partners is rich, while information about competitors is collected in a standardised way, in a specific data base. The information is in order to evaluate their importance and successful market access.

### **The proceeding, fit, and feasibility module in case 7.**

The proceeding in this organisation can be described as technology driven. When a new technology or a new feature has been developed, it will be evaluated for market success. For the reason that technologies come from technology fields, where competence is available, market access becomes the critical criterion for feasibility and fit evaluation. In this context, methods are in danger to be used as means for satisficing, and not as means to compensate satisficing behaviour. In the analysed organisation, a stage-gate process is applied, and the criteria for each gate are well defined. This clear definition leads to satisficing behaviour. Strategic fit is defined by financial business planning, feasibility by market access and technological feasibility. The customer needs evaluation does not play a major role at case 7.

### **Case 8: Smart access systems- potential complex mass products.**

The analysed case study organisation provides software solutions which enable the processing of video information for security applications. The software is applied to identify persons, smoke or explosives from video data. With its 25 employees, case 8 delivers complex high-tech software for integrators who supply complete security solutions for banks, airports and other clients. Case 8 works mainly in collaboration with suppliers and clients. This makes case 8 an organisation a complex mass-product supplier, who predominantly solves a defined but part of the customers' problems, the supply of complete modules. Case 8 regularly participate in funded projects about innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the Managing Director, who is responsible for new business development and key account management. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 8.**

The problem of clients and their clients is the protection of potentially vulnerable objects. The provided problem-solution offers new ways to process visual information in order to improve security gates in banks, airports, or other security relevant institutions. The need dimensions are various and context specific, because it is the clients' need to protect their buildings from unauthorised access. Different criteria for access and different contexts lead to multiple applications and problem solving potential. The provided solution only solves part of the security problem, and it has to be integrated in a complete security system. The customer needs are specific, but can be grouped to representative sub groups. The needs are explicable, however in different contexts dependent to the existing security system.

The identification of customer needs takes place in projects together with an integrator who normally is the direct client of case 8. As a result, customer needs related to the provided problem-solution are generalisable, however context specific in terms of implementation in the existing security system. Case 8 improves implementation skills with every project, based on customer feedback. However, the identification of new customers and of customer needs is conducted by observing external influences of potentially vulnerable clients. News of business and politics, and observing the legal situation in different countries is part of the identification task. Evaluation of customer needs then is based on a more qualitative procedure. It can be predicted that the software might be needed, and the information can be aggregated to market potential data. However, the potential client needs to understand the provided problem-solution and its context. As a result, the evaluation of customer needs also is more rich and less standardised.

### **The technology and problem-solution module in case 8.**

The problem-solutions are standardised software algorithms and integrated systems. The problem-solution itself is a piece of technology, which is self-developed and fitted with the system integrator. Process technology is only relevant in terms of software development. Here standard technologies are used, there is no specific need for process enabling technology.

The approach for identifying and evaluating new technology is an unstructured and little formalised process. Here contacts to the basic research community and the scanning of journals are relevant. It is more a qualitative, little formalised process, however a wide array of sources is used. Rich communication dominates.

### **The co-operation and competition module in case 8.**

The strongest resource is technology know-how. Predominantly direct and substitutes competitors are to be found. Product development projects are conducted together with clients, who are product integrators.

The identification of collaboration partners and competitors takes place at trade fairs, because of the oligopolistic market structure. Information about competitors is used to identify future problem-solution components that might be necessary to develop. As a result, this communication process is conducted with high richness, structuredness, and little formalisation and standardisation.

### **The proceeding, fit, and feasibility module in case 8.**

Methods play a minor role at case 8, they evolve in the concrete problem situation. Organisational fit and feasibility are seen as available, as long as competitive products can be overridden. In this specific case, strategy develops out of the customer relationship.

## **Case 9: High-tech communication technologies -towards complex mass products.**

The analysed case study organisation is a multinational high-tech consumer electronics supplier. The analysed products are mobile telecommunication end devices for voice and data transmission to be applied by consumers and business clients. Case 9 work in strong collaboration with suppliers, co-suppliers and product integrators. In order to develop end devices, case 9 acts as both, an integrator and mass-producer at a time. This makes case 9 a complex mass-product supplier, who predominantly solves a defined part of the customers' problems, the supply of complete end products. Case 9 regularly participate in best practice communities about innovation methods, and they regularly publish findings about their innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the Vice President Business Innovation, who is responsible for new product development. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 9.**

The customer problem is not to clearly defined in detail, only on a general level. In this technology driven industry, customer problems evolve with the offer of new products. The offered problem-solutions address needs of mobile individuals and groups of individuals. The numbers of need dimensions and application contexts are high, and thus the problems can be regarded as complex,

and partially specific. As customer needs are partially implicit, the needs cannot be completely evaluated.

Customer needs identification and evaluation is based on three approaches. First, there is the classic market research that provides quantitative information about target groups who might have homogenous needs. Further, there are trend scouts, who evaluate in a more rich and qualitative way, for example with focus group methods the needs of representative samples of customers. In order to identify completely new customer needs, case 9 sends out wanderers, who integrate themselves in future customer groups in order to observe their behaviour and implicit needs. As a result, here a high triangulation of sources and methods can be identified, a highly structured and mixed formalised and standardised proceeding can be seen. Rich communication and standardised information collection methods with less richness are applied together. For idea generation, a wide variety of creativity and evaluation techniques is available and applied.

### **The technology and problem-solution module in case 9.**

The delivered products contain technology, which is an important part of the problem-solution. Problem solving technology depends on the product technology and thus is flexible to be acquired. This means that even the production of devices can be outsourced. Process enabling technology is not relevant in this case. As a result, at case 9 business is driven by problem-solution technology.

The identification and evaluation of technologies takes place in internal development and in close contact to the research communities. The processes show a high degree of triangulation and high richness in communication due to the high degree of cooperation with external parties. The proceeding is less formalised and standardised.

### **The co-operation and competition module in case 9.**

The strongest resources are market access and technological competence. Mainly direct competitors and substitutes are to be found, further co-suppliers compete for customer contact, as the telecommunication market converges with information technologies. Case 9 collaborates with technology developers and co-suppliers in order to develop end devices.

Methods are implicitly used at case 9, there is no explicit method for identification and evaluation of collaboration partners. In the most cases, collaboration partners are basic technology providers or clients like co-suppliers. These partners are either known because of the oligopolistic market structures, or they actively offer collaboration to case 9. Further, technology partners are identified from research communities and evaluated in the course of technology evaluation projects. As a result, triangulation of sources and methods can be described as comparably low. Rich, little standardised and formalised communication helps to identify the quality of partners.

### **The proceeding, fit, and feasibility module in case 9.**

In this organisation, methods are of high importance. They are implemented in the organisational structure, for example by the assignment of scouts and wanderers who apply their individual methods. In order to develop innovation concepts, the organisational strategy is existing as a frame, and also explicitly communicated in criteria for concept selection. These criteria comprise a certain market size, the availability of international markets, and also disruption potential. This means, that cannibalisation of existing products or technologies makes an innovation concept more important than others. Feasibility is evaluated in the course of pre-projects.

## **Case 10: Smart sensors in cool chain monitoring- complex mass services.**

The analysed case study organisation provides a product service combination that comprises sensors, monitoring hard- and software, and individual monitoring services, like the alerting to prepare intervention. The problem-solution is applied to monitor cold chains in food transport. With its 5 employees, case 10 delivers a standardised, complex problem-solution for super markets, transport and logistics suppliers and food producers. Case 10 works in close collaboration with specialised suppliers and lead clients. This makes case 10 a complex mass-product supplier, who predominantly solves a defined part of the customers' problems, the supply of complete modules. Case 10 regularly participate in funded projects about innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with the Managing Director, who is responsible for product development and marketing. Further, press releases, company web site, and company brochures served as a basis for data collection.

### **The customer needs and market potential module in case 10.**

The customer problem is that legislation and their customers demand a complete cold chain for transportation and storage of food and other sensitive products, like meat, fruit, dairy or pharmaceuticals. These products often have long ways of delivery from the location of production to the point of sales. These cold chains have to be monitored because the maintenance of a cold chain is a technological, time and cost related problem. For the reason that the transportation of these products is conducted by contractors, their reliability has to be monitored.

The number of need dimensions is comparably low, as only part of the problem can be solved by the offered problem-solution. The offered solution only identifies cold chain problems, and it indicates that intervention is necessary. The offered solution is mainly applied in the cold chain sector, however smaller modification of sensors make different applications like fire or theft protection, container pollution and several other applications possible. As a result, the potential need dimensions are low, but application contexts are various. The specificity of customer needs is comparably low, as homogenous groups of customers can be identified, although different organisational contexts have to be supported. The customer needs are explicable, as they are determined by the offered solution and by legal requirements. In addition, case 10 is actively involved in setting up a quality label and driving legislation in order to more emphasise the clients' customers' needs.

The approach to identify and understand customer needs is structured, but highly specific and conducted with rich and little formalised communication. The specific customer needs are evaluated and then generalised to the whole population. This organisation works with a large lead client, and thus triangulation of sources is low.

### **The technology and problem-solution module in case 10.**

The technological problem-solutions are identified from requirements definition with customers, and by technology development. The driver for case 10's business is problem-solution technology. As a result, problem-solution process technology is of comparably less importance, because the technical components can be acquired from the market.

In the first step, technology was developed in academic research projects. In the further proceeding, the core technology was further developed and specific components were externally acquired. The core technology is the combination of radio transmission and a relay together with software that

allows the processing of information transmitted by the sensor. Identification of technological problem-solutions is closely tied to the research community and thus there is strong triangulation and usage of different media like personal contacts and journals. Communication richness is mainly high, communication is less standardised and formalised.

#### **The co-operation and competition module in case 10.**

For case 10, the strongest resource is their technological competence and their market access, which is being built up. Mainly direct competitors and substitutes are to be found in the market. In order to generate the problem-solution, case 10 collaborate with suppliers and clients.

The approach for identifying and evaluating collaboration partners is more qualitative and intuitive. The partners are selected from a network that is provided by the local cluster network, competitors are identified and evaluated from trade fairs and publications. Competitors are used to identify additional possible problem-solutions and to identify future potential clients. Triangulation here is high, although the process is not standardised or formalised.

#### **The proceeding, fit, and feasibility module in case 10.**

At case 10, methods are applied more intuitively, methods are only used in specific situations to solve specific problems. No standardised methods are used. Organisational fit is defined by technical possibilities and by the needs of lead clients. This is due to the young organisation and the absence of other resources. As product development and technology development are conducted by a small team, explicitness of strategy is not important. Feasibility is dependent to collaboration partners, and technical feasibility can be evaluated in the course of product development.

### **Case 11: Facility Engineering -an integrated ctc project business.**

The analysed case study organisation provides services in the field of clean-room systems technology. Case 11 offers consulting, design, construction, and operation of clean room production facilities for large organisations who produce electronic components or food. With its worldwide 8.200 employees, case 11 facilitates the generation of a complex problem-solution, which is integrated and bundled from many internal and external suppliers. Case 11 works in close collaboration with specialised suppliers and its clients. This makes case 11 an organisation in the integrator situation, that delivers a large part of a customer problem-solution. Due to the close collaboration with clients, case 11 can be allocated near to the close-to-the-customer situation. Case 11 regularly participate in funded projects about innovation methods, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with a manager in the "corporate center" division, who is responsible for the organisational development, strategy development, and new business development. There is no organisational instance exclusively responsible for the management of innovation. Further, press releases, company web site, and company brochures served as a basis for data collection.

#### **The customer needs and market potential module in case 11.**

Clients of case 11 need new production facilities and normally know how to produce the products they use the facilities for. When it comes to the decision to install new production facilities, many

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issues have to be addressed: logistics, room design, regulation, production technology (especially clean room technology), security, communication, and many more. The number of need dimensions and the interdependence of needs is very high, many contexts have to be considered. The specificity of customer needs is comparably high, however there is standardisation potential in certain industries. The needs are explicable, however complex and strongly interdependent, needs can also be expressed in a quantitative way.

In order to identify and evaluate customer needs, qualitative and quantitative methods are applied. Here it is important to stay in close relationship with the client, and to anticipate the clients' needs by observing their customers' needs. So is it possible, that a certain production facility type like the production of television set glasses is no longer important, but TFT displays become more relevant. As a result, the needs of future clients can be anticipated. Many sources are used in order to anticipate customer needs, predominantly publicly available sources. Customer needs are evaluated by account managers, who stay in close contact with their clients. Specific customer needs are evaluated in the course of projects. New concepts are developed by technicians, who participate in projects. The richness of communication is high. In the later implementation phase, richness decreases. The process is not formalised or standardised.

### **The technology and problem-solution module in case 11.**

The problem-solution is technology, which is incorporated in a production facility. The role of problem-solution process technology is dependent on each project and thus to be flexibly acquired. The role of process enabling technology is less important than expected in the research propositions.

Technicians develop and evaluate technological concepts which they think clients might need. The identification and evaluation of technological features is not standardised, there is little importance of methods. Triangulation of information sources is high, the technicians' competence is trusted. When a new technology is identified from suppliers or from the research community, then there is a trial implementation. In many projects, costs for a trial implementation are too high, so that technology is evaluated in the course of running projects. There are rich communication processes, which are less formalised and standardised.

### **The co-operation and competition module in case 11.**

The strongest resource for case 11 is the customer relationship, expertise in customer needs, and knowledge about facility engineering. Mainly direct competitors and clients as competitors are to be found. However, competition is not very important, as it depends on the clients' procurement policy which supplier is used. In order to deliver a problem-solution, case 11 collaborates with all kinds of suppliers. In earlier times, case 11 was a producer for ventilation technology and integrated its own products. Today, this technology is produced externally.

Suppliers are normally well known, as the market structure is oligopolistic. Thus, triangulation here is low, and in order to evaluate a supplier a trial project is the best information source to evaluate them in a structured, mainly qualitative and quantitative way. The evaluation processes are not formalised or standardised.

### **The proceeding, fit, and feasibility module in case 11.**

In this case, standard methods are not of high importance, they rather evolve in individual situations. There is no standardised innovation process in this case, the process can be described as "top-down



suggestion system". When innovation potential is seen at top management level, the new problem-solution will be developed and offered. Most of the new concepts are developed for a unique project, and then re-offered. Feasibility thus is evaluated in the concrete project, and organisational fit is determined by organisational strategy and top management attention.

### **Case 12: Digital video broadcasting -commodity and mass product integration.**

The analysed case study organisation is a world-wide active mobile network operator. For the analysed problem-solution, case 12 offers their customers digital video broadcasting services. Case 12 enables their customers to receive video content from their mobile end devices. As an integrator, case 12 facilitates the generation of a complex problem-solution, which is integrated and bundled from many internal and external suppliers. Case 12 works in close collaboration with specialised suppliers and co-suppliers. This makes case 12 an organisation in the integrator situation, that delivers a complex, standardised end product. Case 12 regularly participate in funded projects about innovation methods, and they regularly publish new insights about their methodological approach, which makes them a competent partner for a discussion about innovation methods. The case study data was taken from a semi-structured interview with a senior project manager in the group R&D division, who is responsible for the pilot project of digital video broadcasting introduction in Germany. Further, press releases, company web site, and company brochures served as a basis for data collection.

#### **The customer needs and market potential module in case 12.**

The needs in this technology driven market cannot be reliably anticipated, as customers normally become aware of them with the new product introduction. When the offer for mobile entertainment is given, customers will have a need for a receiver and access to digital broadcasting content.

Customer needs are not explicit, often they can be identified from taking parallels from other industries. The number of need dimensions is high, and they are predominantly multi-contextual. The specificity of needs is high, but can be identified for homogenous groups of customers.

The approach for the identification and evaluation of needs is predominantly qualitative, with support of quantitative market information. At case 12, a certain market size is assumed by taking parallels from similar markets. In order to collect information, a high triangulation of sources is applied. Over time, information becomes more concrete and quantitative. Information and communication media vary in richness, but for the further development, richer media are necessary in order to integrate all necessary collaboration partners. Processes are less standardised, partially structured and less formalised.

#### **The technology and problem-solution module in case 12.**

At the end, the delivered problem-solution is media content. However, content cannot be received if several technological components do not act together. Thus, problem-solving process technology is a key factor in this case. This technology is developed by co-suppliers who need to be facilitated in order to enable an integrated solution. Process enabling technology is an important factor for case 12, because this guarantees their position as an integrator. The role of the integrator is to provide access and enable the billing of the offered services, and thus standards need to be designed carefully to enable successful technology and content integration.

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The identification and evaluation of technology is conducted by a mixed approach, with qualitative and quantitative methods. Tests and trials are the most important sources for technology information, after they have been identified from the research community. Collaboration partners serve as further sources. Thus, triangulation and richness of used media are high. The processes are not standardised and less formalised.

### **The co-operation and competition module in case 12.**

The strongest resources are market access, customer relationship and enabling technologies. Competitors are to be found among co-suppliers who could implement the solution without support, but who have no access to customers. Further, direct competitors are relevant. In order to deliver the problem-solution, case 12 works in close collaboration with co-suppliers.

In order to identify and evaluate co-operation partners, a structured, but informal and unstandardised process is conducted. It is important to be enabled for collaborative technology development and thus, a pilot project is a good way to find out about the qualities of a partner. The market structure is oligopolistic and thus, identification of partners and competitors plays a minor role.

### **The proceeding, fit, and feasibility module in case 12.**

The broadcasting technology was identified, because it was assumed that it can compensate some weak points of mobile radio transmission. Especially the bandwidth is seen as a constraint for mobile entertainment services. Only a field trial could prove this. Thus, collaborative technology development and requirements definition had to be conducted. The existence of customer needs was assumed at the beginning of the project, but a concrete application of the new technology was not known at the beginning. Organisational fit was seen as given, because the most important values about market size are seen as given. Further, average revenue per user and image fit and further, the strategic positioning as integrator were important factors. These factors are discussed in an ongoing process and thus, the current frame of strategic action was known. Normally, when a new idea is generated, the concept developer is looking for arguments to fit the strategic frame. Technical feasibility is evaluated in a pilot project.

## Appendix 2: Interview Guideline and Stimuli.

### Interview Guideline.

Introduction and finish		
Introduction	(find a common language, check innovation focus)	<b>What products or services are you offering?</b> When you introduce anything new or renew a product, service or process, what does the result normally look like?
Introduction or finish (depending on Interviewee attitude)	(Explain the background and basic, summarised research model (NOT research propositions) to explain the reason for the interview questions).	<b>[confront with theoretical framework] Do you agree with this distinction of situations?</b> Where would you position your company?
Activity Modules		
Module	Central task	Questions
Fit and feasibility.	Define the central problem, find or improve a solution with technological means to increase profit.	<b>General</b> Is there a standardised process for the generation of innovations?
	Evaluate the overall feasibility, the necessary steps and resources to implement the project.	<b>Information Collection</b> How do you collect information, which kind of sources do you use? Why this type of sources and not any other?
	Evaluate whether the idea does fit and is attractive enough to the organisation, its strategy or part of it.	<b>Information Processing</b> Which methods do you use to process information, why these and not any other?
Customer needs and market potential.	Evaluate customer problems that can be solved by technological means and evaluate the overall sales potential	<b>Information communication</b> How do you communicate the information, why?
Technology and problem-solution.	Evaluate existing and new technologies, whether they allow to solve the problem adequately and profit-optimised	Do you think this is due to your organisation or is this due to the type of information?
Competition and co-operation.	Define, find and evaluate possible competitors, their interests and possible strategic activities.	
	Define, find and evaluate possible co-operation partners, their interests and possible strategic activities.	

### List of Information sources.

The following list of information sources was used to stimulate the interviewees' replies. This list of stimuli was sorted by actors, who can act as information sources, occasions to find or to meet information sources, and media that can contain the information.

<b>Actors</b>	<b>Occasions</b>	<b>Media</b>
Internal actors.	Standardisation associations.	Newsletters.
Co-operation partners.	Trade fairs.	Scientific journals.
Competitors.	Information events.	Magazines.
Customers.	One-to-one occasions.	Databases.
Information service providers.	Patents and IPR Information.	Public access internet.
Universities.		Product brochures.
Research institutes.		Direct observation.
Official institutions.		Direct communication.

### List of Methods for information processing.

The following list represents a sample collection of methods to identify and evaluate information within the activity modules. This list was used as a stimuli to support the case study interviews. In order to illustrate the theory developed in this thesis, the list is categorised by activity modules. This table aims to illustrate the mapping of methods and their fit to activity modules.

<b>Market potential and customer needs</b>	<b>Technology and Problem-solution</b>	<b>Co-operation and Competition.</b>	<b>Proceeding, fit and feasibility.</b>
Complaint management.	Stretcher concepts.	Patent analysis.	Net present value analysis.
Shadowing.	Quality function deployment.	Porter's five forces framework.	Scenario technique.
Customer satisfaction analysis.	Disruptive technologies.	Resource-based Analysis.	Business planning.
Lead user analysis.	S-Curves.		Portfolio planning.
Tool kits.	Industry life cycles /dominant designs.		SWOT analysis.
Kano method.	TRIZ.		Creativity techniques.
Conjoint analysis.	Creativity techniques.		
Market potential analysis.	Delphi method.		