Department of Industrial Engineering and Management

Decision Makers' Use of Intuition at the Front End of Innovation

Olli Hyppänen

Aalto University

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Decision Makers' Use of Intuition at the Front End of Innovation

Olli Hyppänen

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Abstract

With regard to creating new products, the front end of innovation has been judged to be the most important place for decision making. This dissertation studies the decision makers' use of intuition at the innovation front end. The findings in managerial decision making research suggest that decision makers most often use intuition in uncertain situations. Innovation front end is one environment with high uncertainty. The use of intuition in decision making has not been extensively researched at the innovation front end context and the empirical research data in particular is almost nonexistent. Existing research in innovation front end decision making has concentrated on building traditional normative models to deal with uncertainty.

Empirical data for this study was gathered by interviews and a survey questionnaire from 4 ICT companies. Altogether 19 experienced decision makers took part in in-depth interviews. Survey data consisted of 86 survey responses from experienced and inexperienced decision makers. The grounded theory method was used to build a framework about the use of intuition in front end decision making, which was the main contribution of this research. The empirical data was analyzed by looking the data using several encounters which focus on separate aspects over the studied phenomena. Survey data was analyzed using statistical methods.

The findings of this study suggest that intuition plays a major role for experienced decision makers when making innovation front end decisions. Four facets in revealing the use of intuition were discovered: Symptoms, preceding enablers, simultaneous enablers and safeguards. This research also shows what kind of approaches decision makers take when using intuition. Seven different approaches were found: Drifter, thinker, negotiator, tester, discoverer, believer and seer. The difference in the use of intuition between experienced and inexperienced decision makers was also studied. Both (experienced and inexperienced) decision maker groups have same level of belief over the use of intuition in decision making and they also use it in same extent.

This study contributes to the intuition in decision making and innovation front end literature by describing what approaches decision makers have in using intuition and by establishing new methods to study the use of intuition in decision making. The four facets which reveal the use of intuition establish a concrete way to study the use of intuition. The approaches, what decision makers have, bring more understanding on decision makers' intuition use and how that may reflect on managerial activities. The findings also stress that the role intuition plays should receive greater acknowledgement in innovation research.

Keywords Intuition, decision making, uncertainty, front end, innovation, innovation management, New Product Development

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Tiivistelmä

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Tekijä
Olli Hyppänen

Väitöskirjan nimi
Päätöksentekijöiden intuition käyttö innovaatioprosessin alkupäässä.

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Tiivistelmä

Innovaatioprosessin alkupää on todettu tärkeimmäksi päätöksentekopaikaksi koskien uusia innovaatioita. Tämä väitöskirja tarkastelee päätöksentekijöiden intuition käyttöä innovaatioiden alkupään päätöksenteossa. Tulokset johtajien päätöksenteon tutkimuksesta osoittavat, että päätöksentekijät käyttävät intuitiota useimmiten epävarmoissa päätöksentekotilanteissa. Tuotekehityshankkeiden alkuvaiheen päätöksentekoa pidetään yleisesti sellaisena, jossa epävarmuus on korkea. Intuition käyttöä päätök-senteossa ei kuitenkaan ole juurikaan tutkittu tuotekehityshankkeiden alkupään päätöksenteon yhteydessä. Varsinkin empiirinen tutkimus alalta on ollut vähäistä. Nykyinen tutkimus on keskittynyt lähinnä kehittämään uusia rationaaliseen päätöksentekoon liittyviä malleja vähentääkseen epävarmuudesta johtuvaa päätöksenteon vaikeutta.

Empiirinen aineisto tähän tutkimukseen kerättiin haastattelujen ja kyselytutkimuksen avulla. Aineisto kerättiin neljästä tuotekehitystä tekevästä informaatioteknologian alan yrityksestä. Aineisto koostuu 19 kokeneen päätöksentekijän haastattelusta sekä 86 kyselytutkimusvastauksesta. Aineiston analysointiin käytettiin sekä grounded theory-menetelmää että tilastollista analyysiä. Tutkimuksen pääasialliset tulokset intuition käytöstä innovaatioiden alkupään päätöksenteossa saatiin grounded theory- menetelmän avulla.

Tutkimuksen tuloksena syntyi nelitahoinen malli paljastamaan ja kuvaamaan intuition käyttöä innovaatioiden alkupään päätöksenteossa. Tutkimuksen tuloksena syntyi myös malli siitä kuinka kokeneet päätöksentekijät käyttävät intuitiota päätöksenteossa sekä millaisia intuitiiviset päätöksentekijät ovat ominaisuuksiltaan. Lisäksi vertailtiin kokeneiden ja kokemattomien päätöksentekijöiden eroa intuition käytön suhteen. Tulokset osoittavat, että molemmat uskovat intuition käytön hyödyllisyyteen ja myös käyttävät intuitiota omassa päätöksenteossaan.

Tämä tutkimus vie eteenpäin intuitiivisen päätöksenteon tutkimusta määrittelemällä intuitiivisen päätöksentekijän ominaisuuksia sekä esittelemällä uuden tavan tutkia intuition käyttöä päätöksenteossa. Tutkimus kehittää myös innovaatiojohtamisen ja tuotekehityshankkeiden tietämystä kuvaamalla kuinka intuition käyttö tulee esille innovaatioiden alkupään päätöksenteossa ja kuinka intuitiota käytetään tuotekehityshankkeiden alkupään päätöksenteossa. Tutkimuksen tuloksilla on käytännöllistä merkitystä kehitettäessä innovaatioiden alkupään päätöksentekomenetelmiä ja päätöksentekijöiden osaamista.

Avainsanat Intuitio, päätöksenteko, epävarmuus, innovaatioprosessin alkupää, innovaatio, innovaatiojohtaminen, tuotekehitys

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Leif Hilden, fellow student, was the first one to wake me up that we were about to finish the studies – "hey we are going to have our last exam next week". That sparked me to finish the studies – I noticed that now when the obligatory studies are over, maybe I need to do the dissertation too.

Professor Henri Schildt, our principal lecturer in the Helsinki University of Technology ExiMa program, made the post graduate studies feel such an interesting and easy task to do. Well, it was not that easy at all – but interesting for sure.

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This dissertation received financial support from the Academy of Finland. Without it I would have never started to build my initial research thoughts to a form of a dissertation. When they, in the Academy, found the subject of

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Unfortunately my parents, late Ella and Ilmari, were not able to see this work finalized. At least one thing I have learned from them and their Karelian roots – one has to strive persistently whatever obstacles are on the way, never give up - “sortumatta souta vaik´ois vastatuulta”. This dissertation is dedicated to them.

N 6664866 E 375927, January 2013

Olli Hyppänen

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1 Introduction

"We know more than we can tell."

Michael Polanyi

1.1 Motivation

Innovation matters, not only at the level of individual enterprises but also at the level of nations and their economic growth. Business Week regularly lists the top innovative firms in the world. It found that between 1995 and 2005 the median profit margin of the 25 most innovative firms increased almost ten times more than other companies in the S&P Global Index (BusinessWeek, 2009). In Finland the national innovation strategy was published in 2008 (Aho et al., 2008). The strategy resulted in the Innovation Policy Report by The Council of State to the Parliament which was given to the Parliament in 2008. The report states that an innovation system in the Finnish economy is important for surviving in the global competition.

The ability to innovate is a key ingredient in the survival and prosperity of companies, especially in companies connected to product development. Without innovations companies are unable to launch new offerings to the market, develop new business models or define totally new businesses and are therefore not able to grow their business (Dougherty & Hardy, 1996; Porter, 1990). It is evident that the management of innovations is important, however research has shown that the majority of innovation processes or product development projects fail (Cooper, 1999; Liberatone & Stylianou, 1995). New product launches have only a 60% success rate (Hultink et al., 2000). This success rate has not changed at all in over 50 years (Booz et al., 1968). The reasons for failure are numerous: Mistakes in

innovation process execution, failures in idea screening and selection, timing in the launching the products, delays in development and failures in decision making. The difficulty in selecting the best ideas to be further developed is one of the issues that can be solved in innovation management. The selection is about evaluating the available options and then making decisions.

The importance of selection is highest in the front end phase of innovation (Calantone et al., 1999; Cooper & Kleinschmidt, 1987; Stevens & Burley, 2003; Verganti, 1997). Innovation front end is also the focus of this study. In this study, the front end refers to those tasks and activities which are accomplished before the formal development project is launched (Reinertsen, 1985, 1999). Decisions about whether or not to invest in a new idea for further development are made at the front end. The decision making situation at the front end is challenging in many ways because the results of the development can be seen only when the product is ready. At the decision making point there is uncertainty about market, competition, technology etc. (Kim & Wilemon, 2002b; Nobelius & Trygg, 2002; Zhang & Doll, 2001).

Decision making at the front end has been regarded as one of the key factors in successful innovation management (Calantone et al., 1999; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1998; Tzokas et al., 2004). However, the essence of decision making at the front end of innovation management still required more clarification: How are decisions made or do they just happen, is there a thorough rational analysis behind every important decision or are the decision makers just using their gut feeling? There is limited research available about decision making in innovation management, especially concerning the early phases (front end) of the innovation process where uncertainty and ambiguity are highest (Brentani & Reid, 2012; Kim & Wilemon, 2002b; Zhang & Doll, 2001). In addition innovation front end decision making has mainly been studied from a rational analysis and decision making perspective (Calantone et al., 1999; Hart et al., 2003).

Intuition has recently received considerable research attention in strategic management (Dane & Pratt, 2007; Khatri & Ng, 2000), project management (Dayan & Di Benedetto, 2011; Leybourne & Sadler-Smith, 2006), hu-

man resource management (Hodgkinson & Sadler-Smith, 2003a) and in manager decision making in general (Kahneman, 2010; Matzler et al., 2007; Sinclair et al., 2009). The definition of intuition has varied substantially among studies. I have based my definition of intuition on recent studies (see e.g. Dane & Pratt, 2007; Hodgkinson et al., 2008; Sinclair & Ashkanasy, 2005; Sinclair et al., 2009). Thus, intuition in this study is defined as:

"Intuition is an unconscious process involving holistic associations that are produced rapidly, which result in affectively charged judgments".

The literature suggests that many managers use intuition in turbulent environments where the decisions must still be made (see e.g. Burke & Miller, 1999; Sadler-Smith & Shefy, 2004; Shapiro & Spence, 1997; Simon, 1987). Research of the innovation front end has concentrated on describing decision makers' work based on a formal rational analysis in the formal screening and gate decisions (Cooper, 2008; Hart et al., 2003). However, there are also studies which stress that formal rational analysis is not the only component of innovation decision making (Sinclair et al., 2009; Tzokas et al., 2004). One of the components used in decision making is the use of intuition.

This study brings new empirical evidence to the innovation decision making discussion, from a non-rational (use of intuition) perspective, concentrating on the early phases (front end) of innovation in New Product Development (NPD). The division between rational and non-rational decision making is not clear cut. In order to clarify the terminology used in this study, intuition is considered to be non-rational. Traditional normative decision making methods are considered rational. It is acknowledged that the use of intuition in decision making can also be a rational act by the decision maker.

Even though there are some studies that report that intuitive judgment is used in a NPD context (Dayan & Di Benedetto, 2011; Hart et al., 2003; Stevens & Burley, 2003; Tzokas et al., 2004; Yahaya & Abu-Bakar, 2007), the results are varied. This is due to the variety of definitions of intuition and of intuitive decision making and because of a lack in available research instruments needed to study the phenomenon (Sinclair et al., 2009).

The justifiable motivation for this dissertation is as discussed in the previous paragraphs. The empirical evidence about the decision makers' use of intuition at the innovation front end is currently a clear research gap. This study also adds to the previous research on intuition in decision making and contributes to the research instrument discussion on intuition in decision making (see e.g. Sinclair et al., 2009). The approach taken by experienced decision makers when they use intuition as examined in this study, supplements the role descriptions in innovation management and decision making literature.

This study brings new evidence of the use of intuition in the innovation front end and help organizations further understand and develop their innovation management practices. The use of intuition at the front end of innovation is revealed by symptoms, enablers and safeguards, which either make the use of intuition visible in decision making or ease the use of intuition in the decision process. The results of this study complement descriptions of how decision makers use intuition and raises intuitive decision making to a noteworthy position alongside prevailing rational decision making models. Decision makers use the following approaches when using intuition: drifter, thinker, negotiator, tester, discoverer, believer and seer. The results of this study also help in clarifying the intuition concept and its significance in decision making in general.

1.2 Research questions and research scope

The purpose of this research was to explore the front end of innovation, to study how innovation projects are decided upon, who makes the decisions and how those people make decisions. The aim of this research was to gain a deeper understanding of decision makers' use of intuition and to offer new theoretical end empirical insights in the use of intuition in decision making at the front end of innovation. This is achieved by studying the experiences of innovation decision makers and by describing innovation management, decision making in the innovation front end and the decision making styles of the persons acting at the front end of innovation. This is important because by understanding how decision making at the innova-

tion front end works and how the actors – decision makers – operate, helps in further developing innovation management practices.

This research was conducted using Grounded Theory (GT) method. In the context of the grounded theory method the above mentioned broad description of the purpose and aim enabled the first setting of the research in the field. The research method stipulates that the researcher should not conduct the research with pre-specified research questions in mind, because of possible biases of the researcher himself or biases arising from prior literature (Glaser & Strauss, 1967). The more specific content of the research and the research questions arose during the data collection phase as the interviewed persons described what they experienced in the innovation projects. The aim of grounded theory research is to develop an understanding that is grounded in the reality of the persons involved with the studied phenomenon.

The first batch of empirical data of this research consists of 19 interviews with experienced decision makers from 4 ICT companies. The second batch of empirical data consists of the results from 86 questionnaires from innovation decision makers (from one of the previously mentioned companies). During the first interview and the data collection phase the interviewees spontaneously described their experiences and activities on the innovation front end. They spoke about what made innovations possible in the first place, what was exciting, what had forced them to move forward in innovation projects and how the ideas and innovation projects were decided upon. The decisions were about which ideas and "seeds" to follow through with i.e. very early front end phase decisions.

The results of the initial data collection and data analysis phase (first encounter with the data) resulted in list of categories and related properties relevant in the development of the grounded theory framework for innovation front end decision making. Decision making emerged as one of the core categories in the first data analysis phase. At the beginning of the second encounter with the data, the decision making was the main focus of the data analysis. Soon the existence of non-rational elements in decision making emerged as a core category. This category was named as intuition.

This prompted the first research question:

1. *How does intuition reveal itself in innovation front end decision making?*

The data collection and analysis continued simultaneously and resulted in new categories and properties. The properties emerging from the use of intuition in decision making became apparent when the full interview data was examined. This sparked interest in reanalyzing the research data based on the viewpoint of the interviewed decision makers. A second research question then surfaced:

2. *What approaches do decision makers have when using intuition at the innovation front end?*

As a result of the third encounter with the data the approaches that decision makers have when using intuition and role descriptions were resulted. Knowing that the interviewed persons were all experienced decision makers and innovators, the third research question explored the differences between experienced and inexperienced decision makers that had surfaced.

3. *How do experienced decision makers differ from inexperienced decision makers in their use of intuition?*

The research approach concerning the first two research questions is qualitative. The third question is studied using the survey questionnaire and quantitative analysis. The answers to the research questions are investigated based both on the previous literature and on the empirical findings of this study.

This study is limited to ICT companies and method of managing innovation front end. The ICT industry has generally been regarded as innovative and suitable for purposeful sampling (see e.g. Christensen & Raynor, 2003; Tidd & Bessant, 2009) and thus it is a suitable target when studying innovation management. ICT companies were also selected as a research target because of the author's interest in that industry.

The unit of analysis in this dissertation is the use of intuition in product development project front end decision making. Emphasis is on front end decision making and individual decision makers. The use of intuition is

approached from the individual decision maker's perspective. A single project and individual level approach enables rich data and thus more truthful results, since the interview data described front end activities in detailed and focused way (Charmaz, 2006).

The empirical data is limited to Finnish and American owned ICT companies that conduct product development activities mainly in Finland. The decision making context studied in this dissertation is strategic decisions, not normal operative decisions, since the decisions at the innovation front end are more strategic. Decisions were whether an idea was worth forwarding into the development funnel or not. The interview data consists of a sample from interviews with experienced decision makers. The main argument in this study is based on the data from experienced decision makers' description of the innovation front end. Survey questionnaire data is used to compare experienced decision makers use of intuition in decision making with the process used by inexperienced decision makers.

1.3 Structure of the dissertation

Since this dissertation follows the grounded theory method, where the aim is to develop new grounded perspectives on the studied phenomenon, the focus of the dissertation is on the theory development based on empirical data. This is different than an approach which is based on extensive literature review followed by theory and hypothesis development and then verified by empirical data analysis. In order to make the reader familiar with the existing literature, a thorough literature review on the topic of intuition is presented.

Chapter 1 contains the introduction to this study with the motivation and presentation of the research problem and scope.

Chapter 2 describes the theoretical background in the intuition, innovation and new product development and decision making research fields, discusses the main definitions and theoretical concepts concerning innovation, decision making and the use of intuition and presents relevant literature and previous research. The current research gap is also brought visible.

Chapter 3 describes the research design, the methods used and the data that was used in the study. The validity and reliability of the research methods and the data is also discussed as well as the effect of researchers' role in the results of the study.

Chapter 4 presents the empirical findings of the study by first explaining the interview data and analysis and then the survey questionnaire data and analysis.

Chapter 5 discusses the contribution of the study by answering the presented research questions in detail and presents an evaluation of the study. Practical implications of the results of this study and ideas for further research are also discussed.

The final chapters of the thesis are the references and appendices. The appendices are: A: Bibliometric analysis, B: Survey questionnaire used to collect data on experienced and inexperienced decision makers' use of intuition, C: Coding network used in the first encounter of the data, and D: Cross tabulation of the interviewed persons and the codes.

2 Literature review

"Everything is vague to a degree you do not realize till you have tried to make it precise"

Bertrand Russell

The purpose of the literature review is to map the scene with regard to previous research in intuition, innovation, NPD front end, decision making and the use of intuition in decision making and to address the research questions. Innovation and NPD literature complement each other in this literature review and provide broader overview of the existing research. It is to be noted that innovation process front end and NPD process front end are very much alike, especially when we look at the decision making at the front end. That's why this literature review uses literature from both sources. The literature review starts with a thorough analysis of intuition as a phenomenon including the terminology and a review of the use of intuition in decision making, especially in new product development. The review continues with the description of innovation and innovation front end literature. Those sections concentrate on presenting innovation and innovation front end literature in the light of decision making and how the use of intuition is presented in existing literature. Finally the summary presents highlights of the literature review and addresses the research questions, also explaining the current research gap.

A bibliometric analysis was conducted to support the literature review and to verify that relevant theory discussions has been taken into account (see Appendix A). The bibliometric analysis showed that the discussion of innovation management, decision making and intuition is related to a firm's competitive strategy and competitive advantages (Barney, 1991; Porter, 1990), firm's and person's competencies (Cohen & Levinthal, 1990; Eisenhardt & Martin, 2000; Grant, 1996; Prahalad & Hamel, 1990; Teece et al., 1997) and judgment under uncertainty (Benner & Tanner, 1987;

Kahneman, 2003b; Kahneman et al., 1982). This research concentrates more on the person's competencies and judgment under uncertainty than on strategy and competitive advantages research streams. Literature on intuition has also strong connections towards psychology research fields. This research was purposely limited to describe intuition and use of intuition more on innovation management perspective and not go into human psychology research.

2.1 Intuition in decision making

2.1.1 Intuition definitions

Intuition has recently received considerable research attention in strategic management (Dane & Pratt, 2007; Khatri & Ng, 2000), project management (Dayan & Di Benedetto, 2011; Leybourne & Sadler-Smith, 2006), human resource management (Hodgkinson & Sadler-Smith, 2003a) and in manager decision making in general (Kahneman, 2010; Matzler et al., 2007; Sinclair et al., 2009). The literature suggests that many managers use intuition as an approach in turbulent environments where the decisions still have to be made (Burke & Miller, 1999; Sadler-Smith & Shefy, 2004; Shapiro & Spence, 1997; Simon, 1987). The research has reported the various benefits of using intuition in decision making, for example: accelerated decision making, a higher quality of decision making, and solving creative and unstructured problems (Glaser, 1995; Miller & Ireland, 2005; Sadler-Smith & Shefy, 2004).

Intuition as a concept can be viewed as one kind of information processing which differs (however is not the opposite) from analytical and rational processes. Carl Jung was one of the first scientists to theorize about intuition. He characterized intuition as a primary mode of perception which operates subconsciously (Jung, 1926,1989). Chester Barnard made a distinction between logical and non-logical processes (Barnard, 1938). By logical he defines conscious thinking as thinking that can be expressed with words or other symbols, that is, reasoning. By non-logical he meant thoughts that cannot be expressed using words or reason, which consist only of judgments, decisions or actions (based on Barnard, 1938).

In recent studies the human information processing system has been categorized as part of two different cognitive systems. This is also referred as a dual processing system (Sloman, 1996; Sloman, 2006). One of the systems, which is believed to be older from an evolutionary perspective, involves the automatic and effortless learning and processing of information. This system allows people learn from the experience and is thus also referred to as experiential, automatic, tacit, natural, associative or system 1 (Gilovich et al., 2006; Kahneman et al., 1982; Sloman, 2006; Tversky & Kahneman, 1974). Intuition is often referred to in this system. The second system enables people to deliberately learn and develop ideas. It has been referred to as a rational, intentional, deliberate, extensional, rule-based and system 2 (Gilovich et al., 2006; Kahneman et al., 1982; Sloman, 2006; Tversky & Kahneman, 1974). Traditional rational decision making models use this system.

In recent research the notion of split-brain or highly separated information processing systems is rated as an over simplified model of presenting different information processing modes (Sinclair et al., 2009). Instead a model were two information processing systems operate in parallel and interact with each other is considered to have more support both in theoretical and empirical research (Burke & Miller, 1999; Epstein, 1994; Epstein et al., 1996; Gilovich et al., 2006; Hodgkinson et al., 2008; Sinclair et al., 2009).

Daniel Kahneman presented in his Nobel lecture (Kahneman, 2003a) a figure of a three cognitive system theory where perception played a role in both the intuitive and rational systems (Figure 2.1). System 1 processes function in the same way as perception. They are fast, automatic, effortless, associative and emotionally charged. They are also difficult to control and modify. System 2 processes are slower, serial, and effortful and can be deliberately controlled. They are also flexible and rule-governed. The difference in effort provides usually an indication of which system is used. Effortful System 2 processes tend to disrupt each other whereas System 1 processes do not suffer when done in parallel with other activities.

All the process characteristics attributed to System 1 are also attributed to perceptions. The difference between perception and System 1 is that System 1 is not restricted to processing using only current stimulations as percep-

tion is. However like System 2, System 1 deals with stored concepts and can be evoked with language. System 2 monitors System 1 by using reasoning to verify that our intuitions are correct (Kahneman, 2003b). This is a personally dependent function – which may be stronger in some and weaker in others. My argument is that since individual personalities differ there are many different approaches when it comes to the use of intuition in decision making. How experience – learning from the past – affects to the development of intuition and the use of intuition can also vary among individuals. This is clarified in this study by presenting different descriptions of intuitive decision makers along with the approaches they have taken when using intuition at the front end of innovation.

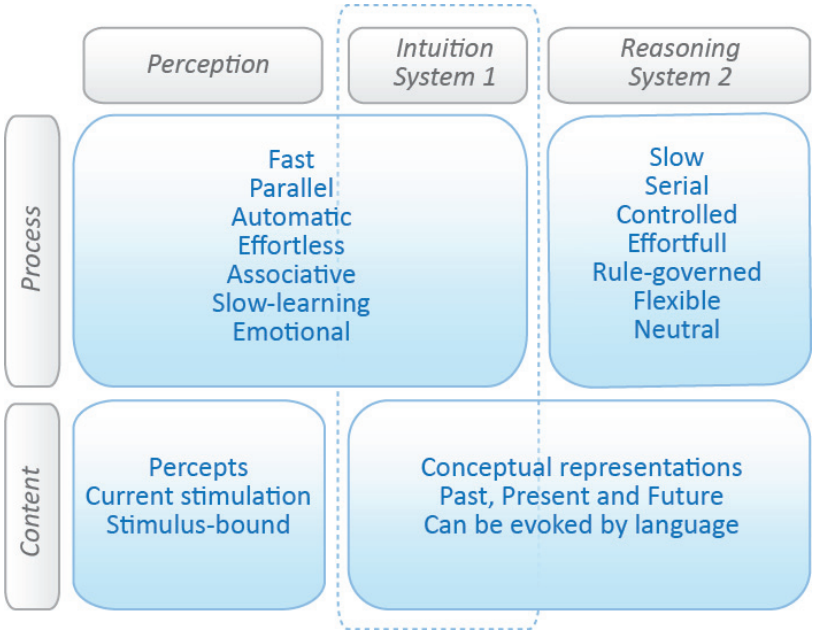

Figure 2.1: Intuition definition (adapted from Kahneman (2003b)).

2.1.2 Intuition as a phenomenon from three different viewpoints

In order to understand the differences between the definitions of intuition and to build up the definition of intuition which is used in this study it is necessary to look at the available intuition definitions from the previous literature in more detailed level. When looking at the intuition phenomenon in more detail, the broad categorization of definitions based on Sinclair et

al. (Sinclair et al., 2009) put intuition definitions into two mutually reinforcing categories (which then makes up the third category):

1. Intuition as an experience-based phenomenon which relies on tacit knowledge accumulated through experience and quick retrieval of that knowledge using pattern recognition (e.g. Banning, 2008; Frantz, 2003; Simon, 1987) .

2. Intuition as a phenomenon incorporating sensory and affective elements (e.g. Agor, 1985, 1989b; Epstein et al., 1996; Parikh, 1994; Vaughan, 1979).

In summary, intuition definitions can be categorized into three groups: the first consists of definitions based on *experience*, the second is based on *affective and sensory* elements and the third category includes more *holistic* definitions of intuition.

The experience based category relies on knowledge, explicit and tacit, which has been acquired through years of practice. Mental shortcuts, pattern recognition and heuristics are associated with this category. Intuition is understood to be based on a deep understanding of the situation, but the decisions happen quickly. In this approach, there is a danger of irrational biases. A summary of experience based intuition definitions are presented in Table 2.1.

Table 2.1: Experience based intuition definitions

Source	Experience based definition of intuition / Intuitive decision making
(Tversky & Kahneman, 1974, p. 1124)	Mental shortcuts – heuristics – that are highly susceptible to irrational biases.
(Simon, 1987, p. 60), (Frantz, 2003, p. 267)	Non-rational experience based activity. Pattern recognition.
(Burke & Miller, 1999, p. 92)	A cognitive conclusion based on the decision makers' previous experiences and emotional inputs.
(Khatri & Ng, 2000, p. 62)	Intuition is based on a deep understanding of a situation. It is a complex phenomenon that draws from a store of knowledge in our subconscious and is rooted in past experience. It is quick, but not necessarily biased as is presumed in previous research on rational decision making.
(Gilovich et al., 2006, pp. 16-17)	Intuitive judgment is not simpler but different than rational judgment and is a result of the use of a limited number of heuristics.
(Miller & Ireland, 2005, p. 21)	Intuition can be conceptualized to 1. holistic hunch 2. automated expertise. Holistic hunch refers to a subconscious gut feeling. Automated expertise refers to a recognition of familiar situations and partially subconscious action.
(Matzler et al., 2007, p. 13)	Intuition is a highly complex and highly developed form of reasoning that is based on years of experience and learning, on facts, patterns, concepts, procedures and abstractions stored in one's mind.
(Banning, 2008, p. 190)	Intuitive-Humanist model is based on experience and pattern recognition.

The affective category links intuition to emotions and feelings. Intuition is characterized as a judgment achieved with a strong feeling of certainty in its truth. Intuition relies on emotions and affect. Intuitive judgments may also develop slowly over time, so feelings and judgments do not have to be immediate. Intuition is based more on sensory elements than on experience. Psychological functions are highlighted in affective descriptions of intuition. The summary of affective/sensory based definition of intuition is presented in the following Table 2.2.

Table 2.2: Affective/sensory based intuition definitions

Source	Affective/sensory based definition of intuition / Intuitive decision making
(Vaughan, 1979, p. 46)	Knowing without being able to explain how we know.
(Benner & Tanner, 1987, p. 23)	Intuition is understanding without a rationale.
(Agor, 1989a, p. 15)	Rational and logical brain skill that can be used to help guide decision making. Affectively charged.
(Jung, 1926,1989, pp. 567-568)	A psychological function that unconsciously transmits perceptions.
(Scott & Bruce, 1995, p. 820)	Intuitive decision making style is characterized by a reliance on hunches and feelings.
(Epstein et al., 1996, p. 401)	Two information processing modes which operate independently but contribute jointly to behavior. Intuition relates to an intuitive-experiential thinking style.
(Allinson & Hayes, 1996, p. 122)	Immediate judgment based on feeling and the adoption of a global perspective.
(Ferguson, 1999, p. 12)	Intuition is a sensory process in human beings triggered by particular kinds of interactions both inside and outside our bodies that influences our stability and optimal performance.
(Rew, 2000, p. 95)	The deliberate application of knowledge or understanding that is gained immediately as a whole and that is independently distinct from the usual, linear and analytic reasoning process.
(Kahneman, 2003b, p. 697)	Thoughts and preferences that come to mind quickly and without much reflection.
(Myers, 2004, p. 1)	Intuition is our capacity for direct knowledge, for immediate insight without observation or reason.

A holistic approach combines cognitive – experience based and affective elements of intuition. Judgments are made without direct knowledge but they require holistic associations from diverse sources of information. Intuition differs from analysis in that it is not transparent and cannot be justified by articulating the logical steps behind the judgment process. The holistic approach acknowledges both sides of intuition – experience based and affective elements – and presents a more complex set of inter-related processes also called dual-process theory (see e.g. Hodgkinson et al., 2008; Kahneman, 2003b). A summary of holistic definitions of intuition is presented in Table 2.3.

Table 2.3: Holistic intuition definitions

Source	Holistic definition of intuition / Intuitive decision making
(Barnard, 1938)	Non-logical processes…which are only made known by a judgment, decision or action.
(Shapiro & Spence, 1997, p. 64)	Intuition is an unconscious, holistic processing mode in which judgments are made with no awareness of the rules or knowledge used for the inference and can feel right despite one's inability to articulate the reason.
(Sadler-Smith & Shefy, 2004, p. 77)	Intuition is the capacity for attaining direct knowledge or understanding without the apparent intrusion of rational thought or logical inference.
(Sinclair & Ashkanasy, 2005, p. 355-356)	Intuition is a non-sequential information processing mode, which comprises both cognitive and affective elements and results in direct knowledge without the use of conscious reasoning.
(Pretz & Totz, 2007, p. 1248)	Intuition is the product of a tacit – experiential – system: affective, heuristic and holistic aspects.
(Gigerenzer, 2007, p. 16)	Intuition is a judgment that appears quickly, we are not fully aware of the underlying reasons but the feelings are strong enough to act upon.
(Dane & Pratt, 2007, p. 40)	Intuitions are affectively charged judgments that arise through rapid, unconscious and holistic associations.
(Hodgkinson et al., 2008, p. 4,19)	Intuition is a complex set of inter-related cognitive, affective and somatic processes for which there is no apparent intrusion of deliberate, rational thought. Intuition is related to the dual-process theory of cognition.
(Sinclair et al., 2009, p. 393)	Intuition is a process leading to a recognition or judgment that is arrived rapidly at, without deliberate or rational thought, and difficult to articulate verbally.

The definition of intuition has varied substantially across studies. One reason is that the term intuition itself has been treated as a process, output of the process of predisposition to use intuition. Many studies, especially those from the 1980s and 90s, did not define the term intuition clearly, which makes it difficult to compare the findings of the research (see e.g. Agor, 1985, 1986; Hayashi, 2001).

Some intuitive definitions relate to spiritual, paranormal and supernatural definitions (Leners, 1992). I have not included that path of research in this study since it is an unstructured arena of science and it conflicts with my ontological standpoint since I am trying to understand and interpret what is happening in innovation front end decision making.

I do not see intuition as a mystic, unexplained phenomenon. In this study, intuition and the use of intuition is regarded as a single component of decision making, a component which has not been clearly understood and ac-

cepted as a serious contender in the innovation front end field. My definition of intuition follows closely with the holistic interpretation of intuition as described by Dane and Pratt (2007), Hodgkinson et al.(2008), Kahneman (2003), Sinclair and Ashkanasy (2005) and Sinclair et al. (2009). The definition of intuition used in this study is the following:

> *Intuition is an unconscious process involving holistic associations that are produced rapidly, which result in affectively charged judgments.*

Intuition is sometimes confused with terms insight or instinct. Instincts are more like biological hard wired reflexes (Epstein, 1990; Hogarth, 2001). Insight is similar to intuition but it is often a lengthy process that begins with deliberate analytical thinking even though the end result may appear to be intuition (Koriat, 1993; Lieberman, 2000; Shirley & Langan-Fox, 1996). With insight the logics and the path to the end result is known at the end of the process, which is not the case in intuition.

Heuristics is often compared to intuition, however they are not the same thing. The use of heuristics is related to low-effort rational strategies where decision makers rely on the presented data to make a conscious guess (which may result in a biased estimate) (Sinclair & Ashkanasy, 2005; Tversky & Kahneman, 1974). Intuition assumes the absence of any awareness of the process used to reach the decision (Epstein et al., 1996; Shapiro & Spence, 1997).

2.1.3 Use of intuition in decision making

In order to study and understand the use of intuition in decision making, intuition and the intuitive process have to be apparent to the researcher. As discussed in previous chapters, the use of intuition is not necessarily a deliberate process. Therefore direct observation cannot be used as a method of observation. Previous research has suggested that intuition is difficult to describe but easy to recognize (Sadler-Smith & Shefy, 2004). This is in part true, but since definitions of intuition are so varied it is also difficult to state are we seeing “similar use(s) of intuition” when comparing previous re-

search. Previous studies have also been inclined to provide more indirect evidence for the use of intuition (Shapiro & Spence, 1997).

Individuals who rely on an intuitive information processing style tend to rely on information filtering based on perception in the information gathering phase (see Figure 2.2). The use of intuition in the information gathering and processing phases has been characterized by Scott and Bruce 1995, (based on Keen, 1973). Those who use the analytical and rational approach, focus more on details in the information gathering phase. This is consistent with long standing managerial tradition in using a Myers-Briggs Type Indicator (MBTI), which has concluded that intuitive decision makers are more likely than others to favor abstract information and perceptual processes and are more inclined to use unconventional and creative behaviors (Gardner & Martinko, 1996).

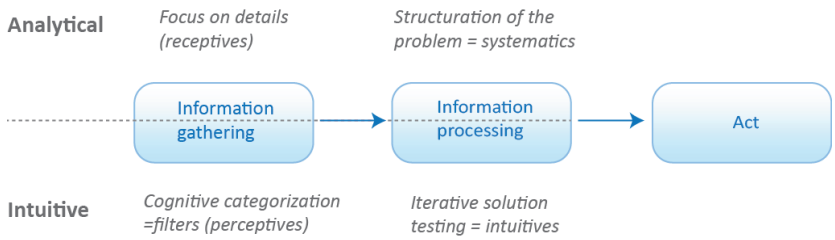

Figure 2.2: Information gathering and processing styles (based on Scott & Bruce, 1995).

The use of intuition has also been described as case dependent. A person who is intuitive by nature does not use intuition in every situation. (Kahneman, 2003b). A judgment or choice is made by:

1. An intuitive judgment or choice is initiated and
   a. endorsed by System 2
   b. adjusts for other features that are recognized as relevant
   c. corrects (sometimes overcorrects) for an explicitly recognized bias
   d. is identified as violating a subjectively valid rule and blocked from of overt expression

2. No intuitive response comes to mind and the judgment is computed by System 2.

The use of intuition has been found to play a major role in effective decision making in organizations (Burke & Miller, 1999; Gigerenzer, 2007; Hodgkinson et al., 2008; Kahneman, 2003b; Kahneman & Klein, 2009; Sinclair & Ashkanasy, 2005) and in strategic decision making (Eisenhardt, 1989c; Khatri & Ng, 2000; Miller & Ireland, 2005; Sinclair et al., 2009). These results from these studies do not universally support the use of intuition. Miller and Ireland (2005) state that intuition is a troublesome decision making tool whereas Khatri and Ng (2000) found that the use of intuition had a positive influence on organization performance in an unstable environment but is negative in a stable environment. Others have just noted the existence of intuition or presented the available tools required to analyze the use of intuition.

The use of intuition among senior managers has also been addressed in numerous studies (Agor, 1986; Dane & Pratt, 2007; Isenberg, 1984; Sadler-Smith & Shefy, 2004; Simon, 1987). Typically the use of intuition is in those studies related to the experience of senior managers or executives. Junior managers' use of intuition has not received the same amount of attention in these studies even though they are commonly mentioned in the results.

The studies by Weston Agor (Agor, 1985, 1986) state that top managers in all organizations differ significantly from lower level managers in their use of intuition in decision making (top managers use more), his empirical evidence is mainly based on studies of the experienced executives. Agor points out numerous techniques to activate the use of intuition and to develop managers' intuitive skills. The results of his studies are so complicated, that the main arguments remain vague and difficult to compare with other studies.

After studying dozens of senior managers, Isenberg found it hard to determine when senior managers actually made a decision and what were the rational methods employed in making those decisions (Isenberg, 1984). The study does not take into account junior managers, but he concludes that "the higher you go in a company, the more important it is that you combine intuition and rationality, act while thinking, and see problems as interrelat-

ed" (ibid, p.81). According to Isenberg, there are five different ways in how senior managers use intuition (sensing the problems existence, rapid reactions, building integrated pictures, check for rational analysis, by-pass analysis). These can be used as a structure for studying intuition and its use among senior managers.

Dane and Pratt (2007) have found that the use of intuition in decision making is effective in complex domain-relevant situations. Their study also proposes that experts, who have years of experience (implicit and explicit learning), are superior in their use of intuition when compared to less experienced decision makers. Their study still lacks empirical data and evaluation, and is only based on the analysis of previous research. They also propose that intuition "use factors" that can be uncovered by observing, could be found out by studying the role of body factors – how people react when they use intuition.

Sadler-Smith and Shefy (2004) present a set of guidelines for developing intuitive awareness (open up the closet, don't mix your I's, elicit good feedback, get a feel of your batting average, use imagery, play devil's advocate, capture and validate your intuitions). Their study is limited to executives and experienced decision makers and did not present the ways in which the use of intuition can be made more apparent. Instead it is stated that intuition is self-evident, without empirical sound evidence.

Entrepreneurs have also been found to make more use of intuition in their decision making than non-entrepreneurs (Armstrong & Hird, 2009). Entrepreneurs who are involved in the early stages of venture creation were also found to possess more entrepreneurial drive. Armstrong and Hird used a Cognitive Style Index (CSI) to study intuitiveness. The instrument itself (CSI) has been questioned since the results based on its use are varied (Hodgkinson & Sadler-Smith, 2003a, 2003b). How decision makers use intuition is also not answered by their results. They raise this issue and indicate that it is an opening for the future research.

Previous research presents different tools in developing and evaluating the use of intuition, and therefore recommendations often differ significantly from study to study. As a result, there are no clear and explicit means of showing how the intuition is used in decision making.

In addition to contemporary management research in industrial economics and management arena intuition has received major research focus in medical schools with regard to clinical decision making (Benner & Tanner, 1987; King & Appleton, 1997; Rew, 2000). When in contemporary management research analytical decision making approaches are main stream, then the use of intuition in decision making is considered traditional in clinical decision making research. Intuition has thus been found to be one of the main components in decision making among medical doctors and nurses.

In most of the clinical decision making studies the use of intuition have been found to have a positive effect on medical decision making. However, criticism towards the use of intuition has been raised by some clinical researchers (Lamond & Thompson, 2000). They argue that the patients and other health care professionals need to know the basis of decisions about treatment and that this is often not possible when using intuition. They also point out that if the decisions are made based on intuition, then they lose the opportunity to learn and share any findings based on those decisions. So, instead of only using intuition in decision making, they encourage the use of analysis in clinical decision making (this is quite the opposite as in traditional management research) (Lamond & Thompson, 2000; Shamian, 1991).

Since intuition is often linked with creativity, the use of intuition has also been researched in connection with the creative design processes (Polanyi, 1999; Raami et al., 2010). The use of intuition has been noted to have a major impact especially on the work of experienced designers. Moreover, in systems intelligence research the use of intuition – or emotions – in decision making plays a central role (Dufva, 2008; Hämäläinen & Saarinen, 2008b; Saarinen & Hämäläinen, 2004). The proposition from a systems intelligence perspective is that decision making must be seen as a system where many components (one of those is intuition – emotions) operate and have to be managed simultaneously. The use of intuition is visible but how it is used and how decision makers use intuition is not explained.

Even though there has been a number of studies concerning the use of intuition, ability and preference, it has been hard to compare the actual re-

sults of these disperse studies. There is also limited empirically sound evidence of the use of intuition in decision making (Hodgkinson et al., 2008; Sinclair et al., 2009). A large part of the results of these studies were from a quantitative survey analysis (Agor, 1989b; Allinson & Hayes, 1996; Benner & Tanner, 1987; Epstein et al., 1996). The research context – intuition – is still an unknown area and difficult to quantify and therefore quantitative methods are not always the most suitable method for this kind of study. Recent studies of intuition have tried to define the constructs of intuition and methods for studying intuition, but they also urge a more analytical and empirical approach for studies of the components of intuition (Hodgkinson et al., 2008). Table 2.4 summarizes the selected references and the use of intuition in decision making related research and their relevance for this study.

Table 2.4: Use of intuition in decision making

Research area	Selected references	Contribution from the selected references	Relevance to this study
Information gathering and processing styles	(Gardner & Martinko, 1996; Kahneman, 2003b; Keen, 1973; Scott & Bruce, 1995)	Intuitive decision makers gather information differently than analytical ones. Use of intuition(system 1) can be combined with system 2 processing.	Means to differentiate decision makers based on information gathering. Case dependent use of intuition.
Intuitive decision making	(Burke & Miller, 1999; Gigerenzer, 2007; Hodgkinson et al., 2008; Hodgkinson & Sadler-Smith, 2003a; Kahneman, 2003a; Kahneman & Klein, 2009; Sinclair & Ashkanasy, 2005; Tversky & Kahneman, 1974)	Intuition as an important component in decision making. Use of intuition and uncertainty are related.	Tools to measure intuition. Different approaches to using intuition in decision making. Decision making styles.
Intuition and strategic decision making	(Eisenhardt, 1989c; Eisenhardt & Zbaracki, 1992; Khatri & Ng, 2000; Miller & Ireland, 2005; Sinclair et al., 2009)	Intuition is used in strategic decision making	Intuition in key roles in strategic decision making. How intuition reveals itself in strategic decision making.
Clinical decision making, Arts&creativity	(Benner & Tanner, 1987; Lamond & Thompson, 2000; Polanyi, 1999; Raami et al., 2010; Rew, 2000)	Intuition as the main decision making approach. Also critics towards the use of intuition on the clinical side.	Connection to disciplines other than management sciences.
Managerial decision making	(Agor, 1985; Dane & Pratt, 2007; Isenberg, 1984; Sadler-Smith & Shefy, 2004; Shapiro & Spence, 1997; Simon, 1987)	Senior managers use intuition in decision making.	Use of intuition is connected to the decision maker role. Differences between experienced and inexperienced decision makers not studied. Empirical evidence missing.
Systems intelligence	(Dufva, 2008; Saarinen & Hämäläinen, 2004)	Intuition as one criterion in systemic decision making.	Intuition is recognized as one component in decision making, but no detailed explanation.

2.2 Setting the scene – Innovation decision making

2.2.1 Innovation definitions

Innovation is a broad concept that can be defined in a variety of ways. Even the definition of innovation as a process or as a result of the process is sometimes mixed. Inconsistencies in definitions of innovation, innovation process and front end process models make it difficult to compare the results of the previous research. Therefore the following chapters define the terms used in this study. The literature presented contains both innovation and new product development front end literature. This is to get a broader picture of the existing research. It is acknowledged that innovation process and NPD process are not the same – innovation process has a broader scope than NPD process. They are however much alike when looking at the decision making at the front end. To severely limit the literature only to the NPD front end would have unnecessarily narrowed the scope – NPD is an innovation activity as such.

Innovation is a commercialized invention as defined by Schumpeter (Schumpeter, 1934). That definition is the basis for many subsequent definitions. Typically discussions of innovations only concern product innovation. Innovations can also happen for example in a service, process and business context. The innovation management literature presents several ways to categorize innovations. All of them use at least two basic elements in categorization: scope or type of innovation and the degree of novelty. Categorization by scope or type (essentially change) can use the following four broad categories (Francis & Bessant, 2005):

- Product innovation: Changes to the things (product/services) that an organization offers.
- Process innovation: Changes in the ways in which products are created and delivered
- Position innovation: Changes to the context in which the products/services are introduced.
- Paradigm innovation: Changes to the underlying mental models that frame what the organization does.

All four categories can then de characterized by a degree of novelty from incremental to radical (also called discontinuous) (Christensen, 2003; Garcia & Calantone, 2002; Tidd & Bessant, 2009). In incremental innovations an already existing product is gradually developed to include new features. This can also be said for other types of innovations (service, process, etc.). It is simply doing what we already do but better. Radical or discontinuous innovation is such where a radically new product or service is commercialized which opens up a totally new business. There can also be discontinuity e.g. in product design because of a discovery of new technological possibilities which makes it possible to do the same but with new and more efficient means. Disruptive innovation is even more extreme than radical innovation. It profoundly disrupts the very basics of business and creates new business models or technologies (Christensen & Raynor, 2003; Christensen, 2003; Leifer et al., 2000; Wheelwright & Clark, 1992).

Whatever the categorization or characterization that is used, the line between the different types of innovations is often unclear because it also depends on context, environment and other variables. Something considered radical in one industry could be incremental in another. It is also hard to see the difference between paradigm innovation and radical innovation. If the innovation is at a paradigm/mental model level it is in fact radical. In practice, the important aspect is that different types of innovations require different kinds of mechanisms for the management of innovations because the complexity and uncertainty so greatly differs between different innovation cases.

When defining innovation it is important to distinguish the innovation process from innovation itself. The innovation process leads to innovation and that process needs to be managed. Much of innovation management is the management of the innovation process. Since the innovation process is understood as a process of turning ideas into reality and capturing the value of their use (Drucker, 1985; Porter, 1990; Rothwell & Gardiner, 1985; Tidd & Bessant, 2009; Trott, 2005), there are defined phases in that process. Descriptions of the innovation process vary as do definitions of innovation itself. In many cases the innovation process has four key phases: search, select, implement and capture. Search refers to how we can find the opportunities to breed further. Select is about making strategic choices about future actions. Implementation is about converting the ideas into reality and

capturing is about how to benefit from what just has been implemented (adapted from Brown & Eisenhardt, 1995; Cormican & O´Sullivan, 2004; Khurana & Rosenthal, 1998). Typically the first two phases (search and select) are called the front end of innovation process. Different studies has been done in order to evaluate and develop practices in these different activities (see e.g. Brown & Eisenhardt, 1995; Cooper, 1990). The development of the innovation process has mainly concentrated on the development of the innovation process so that it is more rational and analytical when it comes to decision making.

The best known rationality based innovation process (actually NPD process) description is the stage gate process model (Cooper, 1990). The basic idea behind the stage-gate process is related to the physical – manufacturing – process where the inputs and outputs of the machine are known and can be controlled. This is the major deficiency in this sort of process description – innovation management is not that rational and cannot be planned in a totally analytical way. This is even more the case at the innovation front end. The innovation process seldom follows a purely linear innovation process model. Instead innovation model descriptions have developed from early linear model descriptions to interactive, flexible and more complex models (Cooper, 2008; Rothwell, 1992; Trott, 2005). The flexibility of the process has been introduced by focusing on the need for communication between the parties, the importance of interfaces and the roles operating in those interfaces and by creating iterations in addition to a pure linear process model.

Based on the earlier studies the following definitions for innovation and innovation process are used in this dissertation:

- *Innovation = (theoretical) conception + (technical) invention + (commercial) exploitation.*

- *Innovation is a result of innovation process which needs to be managed.*

This definition highlights the conception of new ideas as the starting point for innovations. A new idea is not an invention nor is it an innovation, it is just a concept. The process of converting concepts into a tangible new artifact is invention. The commercial exploitation completes the process and takes it to the process of innovation. Invention occurs typically at an indi-

vidual level whereas innovations require a social context. Invention is thus a cognitive process and innovation is a social process (Higgins, 1995; Schumpeter, 1939; Trott, 2005; Van de Ven, 1986).

The innovation process is complex and the management of that process involves the management of several different activities (Cormican & O´Sullivan, 2004; Tidd & Bessant, 2009; Trott, 2005; Van de Ven, 1986). Research also shows that a high proportion of new product ideas fail commercially (Cooper, 1999) i.e. product innovation fails. Liberatone and Stylianou found that less than one sixth of the ideas that enter new product development process are commercially successful (Liberatone & Stylianou, 1995). Based on the study from 1990s by Hultink et al. the new product launches have only a 60% success rate (Hultink et al., 2000). It is remarkable that the success rate has remained unchanged for more than 50 years (Booz et al., 1968; Jones, 1958).

2.2.2 Research on innovation decision making

There are numerous studies which have increased the understanding about decision making in innovation management and new product development. Decision making cannot be viewed only from the NPD process (*organizational*) side. External (*environmental*) factors as well as *individual* factors need to be considered when decision making is evaluated (Balachandra & Friar, 1997; Reid & de Brentani, 2004; Trott, 2005; Van de Ven, 1986). This categorization of innovation management research into three categories *(organizational, environmental, and individual*) is used as a method to organize the existing literature and the empirical findings and to discuss the findings of this research in relation to the previous research. The following Table 2.5 summarizes influential decision making studies in innovation management and the NPD context.

Table 2.5: Selected references of innovation management research (NPD) in environmental, individual and organizational categories.

Component	Selected references	Contribution from the reference research	Relevance to this study
ENVIRONMENTAL			
Life cycle of technology, industry, etc.	(Abernathy & Utterback, 1978; Tushman & Anderson, 1987; Utterback, 1994)	Different life cycles emphasize different aspects of innovation	Changing decision making approaches
Degree of novelty – continuous vs. discontinuous	(Christensen, 2003; Leifer et al., 2000)	Different management approach needed dependent on degree of novelty	Different decision making approaches
High velocity environments	(Brown & Eisenhardt, 1995; Eisenhardt, 1989c)	Fast decision makers use more information and that leads to superior performance.	Decision makers' use of information and decision making style.
INDIVIDUAL			
Individual decision making theory	(Dean & Sharfman, 1996; March, 1994; Nutt, 1984)	Individuals have different preferences about the decision making model that they use (rational approach)	Rational decision making models.
Teams and individuals	(Allen, 1970; Day & Schoemaker, 2004; Eisenhardt & Bourgeois, 1988; Kim & Maubourgne, 1998; Park et al., 2009; Rothwell & Gardiner, 1985; Schmidt et al., 2001; Thamhain & Wilemon, 1987)	Innovative team composition fosters innovation. Team vs., individual decision making performance.	Team innovation as a composition of individuals. Political decision making.
Key individuals	(Allen, 1970; Burgelman & Sayles, 1986; Chakrabarti, 1974; Cooper & Kleinschmidt, 1987; Gemunden et al., 2007; Hippel, 2006; Kim & Wilemon, 2002a; Tushman, 1977; Tushman & Katz, 1980; Zirger & Maidique, 1990)	Roles which facilitate innovation.	Individuals with different competencies and practices. Decision making in relation to individual roles. Sense-making and learning
ORGANIZATIONAL			
Size of the company	(Oakey, 1991; Rothwell, 1983, 1993)	Small firms need to develop more linkages	Complexity in decision making
Processes	(Adams et al., 2006; Calantone et al., 1999; Cooper, 1990; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1998; Krishnan & Ulrich, 2001; Reid & de Brentani, 2004; Smiths, 2002; Tzokas et al., 2004)	The importance of a process approach. More empirical research is needed on processes and decision making systems.	The holistic approach. The Importance of front end phase. Focus on decision making importance. Research gap identified in decision making systems.

The environmental research stream has introduced decision making as a main component of innovation management and the need for different decision making approaches as dependent on the degree of innovation novelty (Christensen, 2003; Leifer et al., 2000). Technology and industry life cycles also have an effect on how innovations are managed (Abernathy & Utterback, 1978; Tushman & Anderson, 1987; Utterback, 1994). Findings propose that different decision making approaches are needed depending on the industry or the technology maturity phase. High velocity environments and decision making in those environments in particular have been studied by Brown and Eisenhardt (Brown & Eisenhardt, 1995; Eisenhardt, 1989c). They highlight the importance of getting more data and especially accurate data from the situations at hand and having faster and more efficient decision making processes.

Previous research on the environmental side has highlighted the importance of decision making in innovation management, however it lacks an explanation of how the environmental aspects affect decision making and how those characteristics that are present in the decision making change the environmental conditions. In fast changing environments the amount of available information and the pace of decision making situations reach its peak in decision makers' "computing capability" and limits further development of decision making practices. Coping with the uncertainty inherent during the early phases of the innovation process has rarely been researched.

Individual perspective deals with the role of the individual in managing and advancing innovation within a firm. Most of the decision making activities in the early phases of innovation are handled by individuals before the organization gets involved in the process (Reid & de Brentani, 2004). When decision making is viewed only from the individual viewpoint, the two most common explanations of individual decision making are logic of consequence and logic of appropriateness (March, 1994). Logic of consequence (rational procedure) assumes that the decision maker has clear preferences, that there are choices connected to those preferences and that the outcomes or consequences of different actions are known (Dean & Sharfman, 1996; March, 1994; Nutt, 1984). The logic of appropriateness is the rule following procedure. The decision maker follows the rules (for example the innova-

tion process description) which they see as appropriate for the decision making situation at hand (March, 1994). In innovation management, logic of consequence of the stage gate innovation management process and a process descriptions itself (rule following) are good examples of how logic of consequence and logic of appropriateness manifest in innovation decision making. The basic assumption in these models is the rationality of the decision maker.

The study of innovation champions has explained the role of champions, gatekeepers and boundary spanners (Allen, 1970; Chakrabarti, 1974; Cooper & Kleinschmidt, 1987; Kim & Wilemon, 2002a; Tushman, 1977; Tushman & Katz, 1980; Zirger & Maidique, 1990). A champion is a person who makes a contribution to an innovation by actively promoting and progressing it in the organization (Burgelman & Sayles, 1986; Chakrabarti, 1974). Gatekeepers are individuals who direct information and who decide whether or not to share information with others. Boundary spanners are the persons who operate at the boundaries of the organization and take care of the link between the organization and outside world (Tushman, 1977). In addition to these traditional roles, other roles like expert, power, process and relationship promoter roles have been identified as having an effect on innovation management success (Gemunden et al., 2007). Another aspect presented by Hippel (Hippel, 1988, 2006) takes users inside innovation and emphasizes their role in decision making in addition to companies' internal contributors.

When individuals are grouped as a team, the performance of the team is dependent on the team structure and on communication networks (Allen, 1970). Team innovation is a composition of the individuals whose qualities have an effect on the total performance of the team (Day & Schoemaker, 2004; Rothwell & Gardiner, 1985; Thamhain & Wilemon, 1987). The best composition is typically a team with diverse individuals (Park et al., 2009). The same applies in decision making performance (Schmidt et al., 2001).

Team decision making can also be analyzed from the viewpoint of inconsistent multiple actors (typically teams are somehow consistent). When the conflicts between the team members cannot be resolved, decision making becomes conflictual or political (Eisenhardt & Bourgeois, 1988). People

need to co-operate voluntarily to get the best results out of group decision making (Kim & Maubourgne, 1998).

The individual side of innovation management research has clearly found that individual persons have a key role in innovation decision making. They are the decision makers who make the final decision in the process. Even though the different roles have been thoroughly described, the current research lacks in its explication of how the individual decision maker ends up with decisions and if there any differences between the different roles in their decision making approach.

The organizational perspective relates to factors coming from organization structure but also from organizational level processes. Small companies require more linkages and networks in order to successfully manage innovations (Rothwell, 1983, 1993). The complexity of decision making thus gets different view in networked and rapidly growing firms (Oakey, 1991). Decision making and interactive structures in internal networks have also been found to be one of the key factors (Birkinshaw et al., 2007) in radical innovation and more empirical research on that agenda has been suggested (Smiths, 2002).

One factor affecting innovation management and decision making is the type of innovation to be managed (incremental, radical/discontinuous) (Drejer, 2002; Garcia & Calantone, 2002; Reid & de Brentani, 2004). Incremental innovations are managed with established processes and organizations whereas radical types of innovations require different skills, management, decision making and problem solving approaches. In incremental innovations the innovation case is typically known in advance - it could for example be an incremental enhancement to a product that is already on the market. Existing innovation management processes exist to handle this kind of decision making and management issues. Problems are structured and organizational structures as well as individual competences are available. The decision making approach in those cases is mainly rational and logical.

New product development research touches all aspects of previously described categories (environmental, individual, and organizational) but it is mostly related to the organizational level processes and issues and product

development innovations (Cooper, 1999; Cooper & Kleinschmidt, 1987; Zirger & Maidique, 1990). Decision making has been raised as a key area of NPD process gate decisions (Cooper & Kleinschmidt, 1995; Hart et al., 2003; Tzokas et al., 2004). NPD studies usually touch on the decisions of later phase innovation processes when the product is already in the development funnel or where the products or services are ready to be launched to the markets (Hart et al., 2003; Krishnan & Ulrich, 2001; Ozer, 1999). In these studies the early phases of innovation process have had less attention than launch decisions. Typically the studies deal with what influences certain decisions can have in the success or failure of the product development (e.g. resource allocation, product concept, product mix, etc.), not on how the decisions were made. They usually present a framework for the decisions that have to be made during different phases of the project (concept development, supply chain design, product design and production ramp up and launch).

Previous research as presented in earlier chapters describes decision making as originating from a central place in innovation management and NPD research. The importance of decision making has been highlighted by previous innovation management research from the environmental side e.g. (Christensen & Raynor, 2003; Eisenhardt, 1989c; Leifer et al., 2000; Tushman & Anderson, 1987; Utterback, 1994), from the individual side e.g. (Chakrabarti, 1974; Gemunden et al., 2007; Rothwell & Gardiner, 1985; Schmidt et al., 2001; Thamhain & Wilemon, 1987; Tushman, 1977) and from the organizational side e.g. (Adams et al., 2006; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1998; Krishnan & Ulrich, 2001; Reid & de Brentani, 2004).

Innovation management is thus much about decision making in each innovation process gate or between the interfaces of different phases in the process. However the essence of the decision making at the innovation front end still seeks more clarification and more empirical research is needed (Smits, 2002). The focus in the vast majority of previous studies is only on the rational decision making models side, with some exceptions e.g. (Reid & de Brentani, 2004; Yahaya & Abu-Bakar, 2007). Previous research, especially in the NPD area, has also concentrated on presenting decision making to the later – more rational - parts of the innovation process (Bacon et al., 1994; Cooper, 1990; Cooper & Kleinschmidt, 1995; Hultink et al., 2000;

Krishnan & Ulrich, 2001; Ozer, 1999; Tzokas et al., 2004) and not on the early innovation process phases (front end) where the most important decision are made (Adams et al., 2006; Calantone et al., 1999; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1998) and where the uncertainty is at its highest (Brentani & Reid, 2012; Kim & Wilemon, 2002b).

2.3 The front end of innovation

2.3.1 Front end activities

To make the innovation process and NPD process more manageable, development projects and processes are typically divided into various stages separated by go - no-go gates (Cooper, 1990; Cooper & Kleinschmidt, 1995). The early phase of the product development process has been called the front end or fuzzy front end since the mid 1980's (Reinertsen, 1985). It has then received wider attention from 1990s onwards (see e.g. Khurana & Rosenthal, 1998; Kim & Wilemon, 2002a; Nobelius & Trygg, 2002; Poskela & Martinsuo, 2009; Reid & de Brentani, 2004; Reinertsen, 1999).

Research has found that by enhancing the decision making process in the early – front end – phases of innovation could have a substantial effect on the success of innovation (Brentani, 1986; Calantone et al., 1999; Cooper & Kleinschmidt, 1987; Rosenau Jr. et al., 1996; Stevens & Burley, 2003; Verganti, 1997). It has also been shown in the previous research that once a development project is launched it is difficult for managers to end it (Balachandra, 1984; Boulding et al., 1997; Cooper, 1994; Schmidt & Calantone, 1998; Schmidt et al., 2001). This accentuates the importance of decision making at the front end of the development projects.

At the front end, the screening phase is where the decisions about whether or not to invest in a new idea for further development are made. The screening phase is challenging in many ways. The results of the development can only be evaluated when they are ready, therefore uncertainty exists during the decision phase. Much of the information concerning the market, competition etc. do not exist at the time of the screening decision and that creates uncertainty and "fuzziness" (Brentani & Reid, 2012; Davila,

2000; Kim & Wilemon, 2002a, b; Nobelius & Trygg, 2002; Zhang & Doll, 2001).

Even though the importance of decision making is highlighted in the previous research of the innovation front end, the terminology and descriptions of the front end phase has not stabilized. At least five different descriptions of the front end can be found in the literature (Table 2.6): The stage-gate model, the new concept development model, the funnel model, the holistic approach and the tailored model (Poskela, 2009).

Table 2.6: Front end process models

Front end process model	Key features	Authors
Stage gate model	Three phases (ideation, preliminary investigation, business case) and three decision gates (initial qualitative screening, second quantitative screening and selecting on business case). Many applications based on the basic stage gate model (number and naming of the phases)	(Cooper, 1990, 1998, 2008) (Khurana & Rosenthal, 1998; Kim & Wilemon, 2002a)
New concept development model	Five front end elements (opportunity identification, opportunity analysis, idea genesis, idea selection, concept and technology development), the engine and external influencing factors. Focus on the element instead of the processes. The Iterative nature of front end highlighted.	(Koen et al., 2001)
Funnel model	A series of funnels consisting of three phases (identify, understand and conceptualize). Decision making gates between the funnels.	(Cagan & Vogel, 2002)
Holistic approach	Strategic level foundations (product strategy, portfolio management, organization) form the foundation for project level activities (product concept, product requirements, market requirements, plans, schedules and resource estimates) to succeed. Decisions between the gates, management has an integrating role leading to the holistic approach.	(Khurana & Rosenthal, 1997, 1998)
Tailored models	The model by Nobelius and Trygg includes the elements: mission statement, concept generation, concept screening, concept definition, business analysis, and project planning. The sequence and durations of these elements are tailored based on the front end case at hand. The model by Reid and de Brentani has three process interfaces (boundary, gatekeeping, and project). The decision maker and the information to and from the interfaces differ based on the decision that are to be made.	(Nobelius & Trygg, 2002) (Reid & de Brentani, 2004)

One of the first descriptions of pre project phase activities is from Cooper (Cooper, 1990, 1998, 2008). He identified three activities in the front end phase stage-gate model: Idea generation, preliminary assessment and concept testing. The purpose of idea generation is to produce ideas and conceptualize them to be assessed in the assessment phase. If the investigation gate in the assessment is passed the concept testing phase concentrates on building a solid business case and an action and launch plan for the product. Several applications from this basic stage gate model with different numbers or names are found in the research (see e.g. Khurana & Rosenthal, 1998; Kim & Wilemon, 2002a).

The new concept development model by Koen et al. (2001) is more iterative in nature than the sequential stage-gate process model. It consists of five phases (opportunity identification, opportunity analysis, idea genesis, idea selection and concept and technology development) (Koen et al., 2001). The model has even more emphasis on the pre-idea phase (opportunity identification and analysis) and it tries to enable the natural back and forth iteration which is typical during the front end phase. The latter phases (idea selection and concept development) are more similar than the previously described stage-gate model.

The front end phase can also be organized as a set of funnels each having a distinct phases (identify, understand and conceptualize) (Cagan & Vogel, 2002). The basic idea of the funnel model is that the ideas that are first filtered through each funnel are then expanded as a source for the following funnel. Decision gates exist between each funnel where the most promising items are forwarded for the next phase.

A holistic approach of the front end process model creates the difference between strategic level elements and tactical level elements (project specific elements) (Khurana & Rosenthal, 1997, 1998). Strategic level foundations (product strategy, portfolio management, organization) form the foundation for project level activities (product concept, product requirements, market requirements, plans, schedules and resource estimates) to succeed. Decisions are made between the phases and management has the integrating role in building a holistic picture between the strategic and tactical elements.

Tailored models include a set of elements which are tailored based on each of the front end cases. Tailoring is done from the foundation of the previously mentioned front end models (typically stage gate model). There are several examples of tailored front end models. Two of them are described below. The model by Nobelius and Trygg (Nobelius & Trygg, 2002) includes the following elements: Mission statement, concept generation, concept screening, concept definition, business analysis, and project planning. The sequence and duration of these elements are then tailored based on the front end case at hand. Management has the critical role in making and tailoring decisions at each decision making gate. The tailored model by Reid and de Brentani describes the front end model by concentrating on the interfaces between the phases and decision making occurring over the interfaces (Reid & de Brentani, 2004). They focus on decision making and on front end process and the focus is on how the decision making and the decision maker (individual or organization) differs between phases.

2.3.2 Decision making at the front end

As stated in earlier chapters, the front end of innovation has in nature the level of uncertainty and "fuzziness" (Brentani & Reid, 2012; Kim & Wilemon, 2002a; Nobelius & Trygg, 2002). There are for example technological and business uncertainties but the decisions about taking an idea further still have to be made. Decision making concerning innovation management in general can be regarded as decision making under uncertainty, especially during the front end phase (Khurana & Rosenthal, 1998; Kim & Wilemon, 2002b).

Different methods supporting decision making at the NPD front end have been developed to overcome uncertainty related problems. Decision making models found in the literature are summarized in the Table 2.7.

Table 2.7: Decision making models used in NPD front end to handle uncertainty

Front end decision making model	Features and use of the model	Authors
Probabilistic models	Probabilistic models uses probabilities and expected outcomes (e.g. revenue) to calculate possible solutions to a problem. Monte Carlo is a process simulation tool. Decision trees to understand and evaluate the path from inception to completion of a project.	(Chapman & Ward, 1997; Souder & Mandakovic, 1986) (Doctor et al., 2001)
Formal scoring methods	In scoring models projects are rated and scored using qualitative questions and criteria.	(Cooper, 1988; Hart et al., 2003; Montoya-Weiss & Calantone, 1994; Tzokas et al., 2004)
Behavioral approaches	Behavioral methods like the DELPHI obtain the most reliable consensus of opinion of a group of experts. Reflective learning and sense-making models rely on individuals' ability to learn and make sense of the information. Trial and error learning methods.	(Dalkey & Helmer, 1963; McGrath, 2001; O´Connor & Veryzer, 2001; Ortt & Smits, 2006; Perminova et al., 2008; Souder & Mandakovic, 1986; Thomke & Reinertsen, 1998; Van de Ven et al., 1999; Weick, 1995)
Analytical hierarchy process (AHP)	Customized decision tree based tool which uses pairing of criteria and ideas as a basis for scoring.	(Calantone et al., 1999; Saaty, 1977)
Fuzzy logic	Fuzzy logic provides the framework to evaluate the possibility of events rather than probability	(Büyüközkan & Feyzioglu, 2004)

The use of intuition has received only minor attention in the prevailing research as was explained earlier in this chapter. Typically, uncertainty in decision making has been handled using traditional risk management methods by assessing the occurrences, identifying probabilities and designing mitigation strategies (see e.g. Chapman & Ward, 1997). A Monte Carlo simulation and decision trees are examples of probabilistic decision models (Souder & Mandakovic, 1986). Monte Carlo uses simulation algorithms to find a solution for a decision problem. Decision trees provide a structured approach for decision making using expected revenue and uncertainty factors (Doctor et al., 2001; Magee, 1964).

Formal scoring methods have been popular in order to manage the decision making in the screening phase (Cooper, 1988; Hart et al., 2003; Montoya-Weiss & Calantone, 1994; Tzokas et al., 2004). In scoring, the

proposals are evaluated against a set of criteria such as: Fit to the strategy, available resources, available technology and financial resources. These studies have concentrated on enhancing the rationality of information collection and analysis.

Behavioral approaches such as the Deplhi method finds a consensus within a team about which projects or decisions to move forward with (Dalkey & Helmer, 1963; Souder & Mandakovic, 1986). It is particularly useful in the early phases where the qualitative information is the main information source. Methods using a trial and error learning and selectionism have also been researched as a management method when dealing with uncertain conditions (McGrath, 2001; O´Connor & Veryzer, 2001; Thomke & Reinertsen, 1998; Van de Ven et al., 1999). Uncertainty can be also managed by means of reflective learning and sense making (Ortt & Smits, 2006; Perminova et al., 2008; Weick, 1995). The way in which decision makers make sense of a situation greatly affects the alternatives that are selected. Continuously reflective learning reduces uncertainty by illuminating learning opportunities (Ortt & Smits, 2006; Perminova et al., 2008).

Analytical Hierarchy Process (AHP) method and tools uses the pairing of criteria and the product idea for selecting the most promising ideas for further processing (Calantone et al., 1999; Saaty, 1977). AHP relies on subjective managerial input on multiple criteria and scorings. Many commercial decision making software tools use AHP models. As the name already states the method is based on analytical evaluation of the criteria.

Fuzzy logic deals with the problems where a source of vagueness is involved (Büyüközkan & Feyzioglu, 2004; Zadeh, 1965). In general, the often used probability concept is related to the frequency of the occurrence of events, while fuzzy sets provide the appropriate framework to evaluate the possibility of events rather than their probability. Fuzzy logic based control has been widely used in different production systems in the industry. The same has been applied to NPD decision support software (Büyüközkan & Feyzioglu, 2004).

Rationality based methods as described above can lead to good and effective decisions. But what if the uncertainty and risk cannot be mitigated or reduced by using the rationality based decision making methods which

prevalent in the research? The basic deficiency of all of the previously described models is that they assume more information and better information for analyzing and solving uncertainty related problems at front end decision making. In some cases that approach certainly has its place but it does not explain the decision making and all of its components. However, when outcomes are difficult to predict through rational analysis and the uncertainties have to be acknowledged and one must be able to face the unknown in a fast way, then the potential of intuition must be recognized.

2.4 Intuition in new product development front end

Even though there are some studies which report that intuitive judgment is used in NPD context (Dayan & Di Benedetto, 2011; Hart et al., 2003; Stevens & Burley, 2003; Tzokas et al., 2004; Yahaya & Abu-Bakar, 2007) the results vary significantly between the studies. Some use quantitative survey based research methods (Dayan & Di Benedetto, 2011; Hart et al., 2003; Tzokas et al., 2004) others use qualitative methods (Yahaya & Abu-Bakar, 2007) and others use some existing instruments (Stevens & Burley, 2003). As was noted in the basic definition of intuition, the studies differ in their definitions of intuition and intuitive decision making which makes it even more difficult to compare the results. Table 2.8 summarizes the recent empirical NPD studies where intuition has also a research target. Two studies from the New Business Development (NBD) and Technology Based Services (TBS) areas where also included in the sample, since the way they handled the development process is similar to the NPD descriptions and the findings can be in part taken as a reference for this dissertation.

Table 2.8: Recent intuition studies in NPD (NBD, TBS) context

Authors	Empirical data	Research method	Findings
(Hart et al., 2003; Tzokas et al., 2004)	228+438 companies in Netherlands and UK. 166 responses.	Survey study. The whole NPD process.	Intuition plays a major role in screening gate decisions (after technical feasibility, product uniqueness and market potential).
(Yahaya & Abu-Bakar, 2007)	6 companies, 16 managers	Interview data, the grounded theory method.	Intuition is used in NPD decision making in strategic management issues and in process issues.
(Stevens & Burley, 2003)	267 projects in chemical companies. (NDB)	Interview data and MBTI indexes.	High N(intuition) and T(thinking) persons deliver better business results for new business development (NBD). They also work more effectively in FFE.
(Van Riel et al., 2011)	251 innovation projects. (TBS)	Survey questionnaire.	The importance of team composition, information usage and decision perspective.
(Dayan & Di Benedetto, 2011)	395 firms in Turkey,155 responses.	Survey study and interviews.	The more turbulent environment the more teams use intuition. Stress has a moderating effect on the use of intuition.

Intuition has been found to be one criteria used especially during the early screening gates of the NPD process (Hart et al., 2003; Tzokas et al., 2004). Hart et al. (2003) conducted a survey questionnaire based study of 166 managers in the UK and Netherlands. The companies all developed or manufactured industrial goods. The results (for British and Dutch companies) show that intuition plays a major role in the idea screening gate decisions (technical feasibility, product uniqueness and market potential still played a more significant role than intuition). Intuition also has a role in subsequent gate decisions, but other criteria were ranked much higher. The responses about the use of criteria varied between the respondent companies, but in general, intuition had a remarkable position in screening gate decisions.

The study by Hart et al. (2003) is based on the survey questionnaire responses from the managers. As a self-report it has the potential for bias either towards good or bad results. They only evaluate the use of intuition, not how the managers used intuition in decision making (what approaches decision makers had). The sample in their study was randomly selected in

company level. They did not report how the respondents of the survey were selected. The demographics show respondents with many years of experience and also those with less experience. However, no difference in the use of intuition was observed based on the experience. They also encourage more research on the importance of the different criteria. It could for example be that even though intuition has not received many scores in other than screening-gate decisions its importance could be high in other gate decisions too.

Similar findings are presented by Yahaya and Abu-Bakar (2007). In their study of six Malaysian technology based companies they found that senior managers use intuition in some situations during the NPD process, especially in dealing with strategic management issues and NPD process issues. Their study is based on interviews of 16 managers from 6 technology based companies. The majority of the respondents have a long (16+ years) work history, so they can be regarded as experienced. They used Grounded Theory as data analysis method in the study.

The use of intuition was revealed in Yahaya and Abu-Bakar's (2007) study from the descriptions the managers gave during the interviews. However, no further description or analysis of the phenomenon was made in the study. The results lack in their ability to explain how managers use intuition in decision making and if there are any individual differences in the use of intuition. They also propose more research to be done in the area of senior decision makers approach to different decision making situations where intuition could be used. Junior decision maker perspectives are also left out in their data and analysis.

A study by Stevens and Burley (2003) evaluated the personalities in new a business development (NBD) context. Even though the context differs from NPD the results are at least partially usable for NPD. A Myers Briggs Type Indicator (MBTI) (Briggs & Myers, 1962) was used as a tool to analyze the personalities of the persons in the NBD projects. They developed a Rainmaker Index (RI) to describe the personality type that is able to provide higher profits than others involved in NBD projects. RI is a direct application from the MBTI NT (iNtuition/Thinking) score modified to take profit generating factors into account. MBTI personality measurement has inbuilt scores for intuitive (N) preferences and that can be used to reveal the deci-

sion makers use of intuition. Stevens and Burley used an interview data from one company over a ten year period. MBTI measurement was done for 69 analysts working on NBD projects during the research period. It is assumed that all the measured analysts were experienced decision makers.

Their findings conclude that intuition (based on the RI index) is the most important success factor for the early stages of the NBD process and that the people are at least as important as the NBD process itself (Stevens & Burley, 2003). Creative – intuitive – individuals as decision makers have been found to be superior at NPD front end decisions. They also point out that higher RI index produces higher profits in NBD projects. However, they did not specify intuitive persons decision making capabilities in more detail.

A recent study from the service development field (technology based services TBS) by van Riel et al. (2011) touches directly the screening phase of innovation projects and decision making effectiveness. A survey questionnaire was sent to 1500 companies and 251 usable answers from senior executives or managers were received. The data in their study shows that operative managers participate more in the screening phase decisions than do CEO or executive level persons.

Their study did not directly discuss the use of intuition in screening phase decision making. The results show that acquiring information plays a major role in screening phase decisions. Gathering information about the external environment was found to have a substantial effect on decision making effectiveness. A strategic entrepreneurial attitude and experience was also found to have positive influence on effectiveness. The authors highlight that the results of their study are limited to some extent by the internal information of the decision maker, which means the intuition and experience of the decision maker. That's why it was not possible to study using quantitative survey based methods and thus the need for qualitative research is addressed in their report.

Another recent study by Dayan and Di Benedetto (2011), which investigates team intuition in NPD project teams, also puts intuition as a main component of decision making. They used a sample of 310 product developers and 155 managers in their quantitative study. They developed their

own measures to evaluate the team level use of intuition. The results show that the more turbulent the environment the more intuitive judgment is used by the decision making teams. Stress has a moderating role in use of intuition and creativity based on their results. Their study was based on quantitative survey data analysis and was supported by interviews.

Dayan and Di Benedetto's (2011) definition of intuitive-rational decision making as a continuum with two ends conflicts with the view that intuitive and rational components can work simultaneously, which is the definition used in this dissertation. Their view is also limited to the team context and does not analyze decision maker's personal approach to the use of intuition. The measures what they used, even though well developed, have not been used anywhere else. Thus the comparability of the results still needs more research.

The essence of the use of intuition at the front end of innovation remains unexplained in the aforementioned studies. Intuition is seen as a decision making component, but the detailed investigation of the phenomena remains weak. Even though some of the studies have also used qualitative data and analysis, the argument continues about its use at higher levels (i.e. is intuition used or not). How intuition is used by decision makers (what approaches decision makers have) has not been the research focus in any of the empirical research what I have been able to locate. The need for future qualitative research is clearly stated in the conclusion of several previous studies. The argument is that the use of intuition has a major role in innovation decision making, especially on the NPD front end phase and that needs more detailed study and explanation.

2.5 Summary and conclusions of literature review

Decision making at the front end of innovation has been regarded as one of the most important factors in innovation management (Abernathy & Utterback, 1978; Brown & Eisenhardt, 1995; Cooper & Kleinschmidt, 1987, 1995; Hart et al., 2003; Khurana & Rosenthal, 1998; Reid & de Brentani, 2004; Schmidt et al., 2001; Smits, 2002; Tzokas et al., 2004). When looking at the literature on innovation management and new product develop-

ment the majority of the research deals with innovation process descriptions and rational decision making methods. My argument is that the challenge of the innovation front end decision making is more complex because it is not just selecting the best from the available options and decision making cannot rely solely on rational and analytical methods which prevail in innovation management and NPD front end literature.

Innovation is about the unknown, about possibilities associated with doing something new and thus the process involves dealing with uncertainty. There has to be a means of dealing with the uncertainty. Intuition has been found to be a component of decision making when conditions are uncertain or ambiguous (see e.g. Kahneman & Klein, 2009; Kahneman & Tversky, 1982; Tversky & Kahneman, 1974) and Table 2.4). Especially in radical innovations (Christensen, 2003; Leifer et al., 2000), in high velocity environments (Eisenhardt, 1989c) and at the front end of the innovation process (Khurana & Rosenthal, 1998; Kim & Wilemon, 2002a) the uncertainty in decision making is high.

Table 2.9 summarizes the present research in connection with the research questions of this study. It should be noted, that even though there are number of studies who have reported how intuition is used and what approaches managers have to using intuition, there are very few – if any - that have had the context of innovation front end in their research as a main focus area.

Table 2.9: Summary of present research in connection with the research questions

Research question.	Selected references	Main arguments	Current research gap
1. How does intuition reveal itself in innovation front end decision making?	(Myers, 2004; Scott & Bruce, 1995; Shapiro & Spence, 1997)	Indirect evidence is available from body cues, info filtering, etc.	No clear ways of describing the use of intuition. Empirical evidence scarce.
	(Adams et al., 2006; Brown & Eisenhardt, 1995; Cooper, 1999; Hart et al., 2003; Krishnan & Ulrich, 2001; Liberatone & Stylianou, 1995; Reid & de Brentani, 2004; Sinclair & Ashkanasy, 2005; Tzokas et al., 2004)	Front end is the critical process phase. Decision making process needs more focus, different processes are needed. Fast decision making leads to better performance.	More empirical evidence is needed in process side. Development has been mainly in analytical decision making processes. More and better instruments needed in order to study the use of intuition.
2. What approaches do decision makers have when using intuition at the innovation front end?	(Gemunden et al., 2007; Isenberg, 1984; Kahneman & Klein, 2009; Kim & Wilemon, 2002a; Pretz & Totz, 2007; Tushman & Katz, 1980; Van Riel et al., 2011; Zirger & Maidique, 1990)	Use of intuition is case dependent. Use of intuition is a personal quality and related to individual roles.	Empirical evidence is mixed and mainly based on quantitative studies. How individuals end up with a decision is not studied. How intuition is related to different roles at the front end has not been researched.
3. How do experienced decision makers differ from inexperienced decision makers in their use of intuition?	(Dane & Pratt, 2007; Hart et al., 2003; Sadler-Smith & Shefy, 2004; Stevens & Burley, 2003; Yahaya & Abu-Bakar, 2007)	Experienced decision makers use intuition.	Does not study inexperienced decision makers use of intuition or empirically compared the differences based on the experience. Self-report studies are prone to bias.

The innovation front end has been regarded as the critical process phase concerning decision making and the development of front end decision making has been requested by the existing research. Development of those decision making practices have mainly concentrated on building better rational and analytical tools to support decision makers in their tasks. The need for intuitive, empirically sound, decision making research has also been raised as an innovation front end research arena. The use of intuition at the innovation front end remains a relatively untouched topic (with the exception of: Reid & de Brentani, 2004; Stevens & Burley, 2003; Tzokas et al., 2004; Yahaya & Abu-Bakar, 2007). This study adds empirics in the form of a qualitative study and analyses especially innovation front end context in high velocity NPD environments.

Use of intuition is related to decision process structure where the role of intuition can be studied. However, the reliability of these surveys has been recently questioned (Hodgkinson et al., 2008; Sinclair et al., 2009). Use of intuition in the decision process has also been studied and found to be remarkable, however the description of how intuition presents itself in the process and what affects its usage still needs more study.

A study of intuition can be targeted to study individual decision maker characteristics where one part is the level of intuitiveness of the decision maker. Current empirical evidence of the subject is mixed and mainly based on quantitative studies. This study complements and challenges current innovation front end research by describing how the use of intuition reveals itself in an NPD context and describes what approaches the decision maker has in the use of intuition in the innovation front end. This is to shed more light on what innovation and NPD management is like – the actual management work.

The experience of the decision maker has been found out to have an effect on the use of intuition, so that experienced decision makers use more intuition or come to better results when using intuition than their less experienced colleagues. However, these results have mainly been accomplished by studying only experienced decision makers (Sadler-Smith & Shefy, 2004; Stevens & Burley, 2003; Yahaya & Abu-Bakar, 2007). This study also takes into account a picture of less experienced decision makers in comparison with the experienced ones.

This study uses two different instruments (qualitative and quantitative) to study intuition in the process and in individuals with intuitive abilities. This is to shed more light in the inquiry of instrumental validity highlighted by Sinclair (Sinclair et al., 2009). This also has an effect on the methodological side of this research which is described later in methodology section.

This research concentrates on discussing decision making processes on a conscious or unconscious level (rational/analytical, intuitive). The supra-conscious level, sixth sense etc. higher level of consciousness is outside the scope of this study since there are no scientific tools available to study its existence (for further details see Sinclair & Ashkanasy, 2005).

3 Research design and methods

"To achieve something you have to have dreams and goals and courage to start the journey without knowing how much it requires effort and how to achieve the goals and persistence to continue despite of the difficulties and obstacles on the way. "

Olli Hyppänen

This chapter explains in detail how the empirical research for this dissertation was done. It also presents the research strategy, approach and methods used in this dissertation and how the methods were used during the course of the research. Finally the evaluation of the validity and reliability of the research as well as the researcher's role is stated.

3.1 Objective and research questions

The aim of this research has been to gain deeper understanding of decision makers' use of intuition and to offer new theoretical end empirical insights into the use of intuition in decision making at the front end of innovation.

The research questions are:

1. *How does intuition reveal itself in innovation front end decision making?*

2. *What approaches do decision makers have when using intuition at the innovation front end?*

3. *How do experienced decision makers differ from inexperienced decision makers in their use of intuition?*

The literature review in the previous chapter clarified that decision making is one of the key areas in innovation front end and new product development. Literature review also points out that decision making has been previously researched mainly from rational analysis point of view and the non-rational (use of intuition) part is largely missing. Also empirical evidence for the use of intuition in decision making is quite limited, especially concerning NPD front end (Reid & de Brentani, 2004; Stevens & Burley, 2003; Tzokas et al., 2004; Yahaya & Abu-Bakar, 2007).

The purpose of this study is to explore the front end of innovation, to study how decisions concerning innovation projects are made, who make the decisions and how the decisions are arrived at by the decision makers. Since few previous studies have approached these issues from a non-rational decision making in NPD stand point, the main part of this study was done using qualitative – inductive – methods.

Mixed interview and survey questionnaire is used as a research method in this study. The researcher – myself – as the main research instrument, observed what happened in the innovation management and decision making process by conducting interviews and thoroughly analyzing the interview data. I also conducted the survey questionnaire with a separate control group. However the results of the survey questionnaire represent only a minor share of the results of this study. The main argument is built from the interview data. The research methods provided a large amount of qualitative interview data and quantitative survey questionnaire data. A detailed description of the data is found in the following chapters.

3.2 Research approach

The research approach using mainly qualitative interview data was selected because the research interest was in studying a complex phenomenon with a tight connection to the field and actual work. Qualitative approach makes it possible to study a complex phenomenon where the available previous research data is nonexistent or limited (Charmaz, 2006; Denzin & Lincoln, 1994; Miles & Huberman, 1994). It also allows the researcher to

stay in close connection with the field and the data and to interpret and construct the meaning from the data. Data analysis is done by using a grounded theory method and statistical analysis (factor analysis and t-test) for the survey questionnaire data. The use of data analysis methods in this study is explained in more detail in following chapters.

Grounded theory as a method of inquiry was selected because the field of decision making and the use of intuition in decision making is a relatively unstructured and unknown field. Thus the grounded theory approach with its iterative data analysis and inductive method is well suited to this study. A unit of analysis in this dissertation is the use of intuition in product development project front end decision making. Emphasis is given to the use of intuition in engineering related innovation management decisions – decisions which are made by individuals. A single project and individual level approach enables rich data and thus more truthful results, since the interview data was able to handle the front end activities in a detailed and focused way (Charmaz, 2006).

The grounded theory was developed by Barney G. Glaser and Anselm L. Strauss during their studies of dying in hospitals (Glaser & Strauss, 1965; Glaser & Strauss, 1967). When they analyzed the process of dying they developed a systematic method of studying many other topics. The method was published as a book “The Discovery of Grounded Theory”(Glaser & Strauss, 1967). The research method favored developing theories from research grounded in data rather than deducing hypotheses from existing theories and testing those. The components of the grounded theory practice include:(Charmaz, 2006; Glaser & Strauss, 1967)

- Simultaneous involvement in data collection and analysis
- Constructing analytic codes and categories from data (not from deduced hypotheses)
- Using the constant comparative method, which involves making comparisons during each stage of the analysis
- Advancing theory development during each step of data collection and analysis
- Memo writing to elaborate upon categories, properties, relationships and gaps

- Sampling aimed toward theory construction (not for population representativeness)
- Conducting literature review after independent analysis

A grounded theory approach sheds light on problems or areas of study through the processes and humans are seen as active agents in their worlds. Social meanings are created by the use of language and emerge through action. Structures are created by processes where human beings are active. These ideas reflect the pragmatism tradition favored by Strauss. This approach also reflects my own personal philosophical stance. I see people as constructing their realities based on how they participate in it. In the same way phenomena in the innovation management is a construct itself. Due to the nature of my data and the method I use, the study has an interpretative and subjectivist nature.

In this study, I will interpret how meanings and actions are constructed in the decision making of NPD front end. The decision making context itself appears to be such a complex area of research that I could not see any way of studying it using a positivist - objectivist approach. My own participation and insight in the innovation field also limits the possibility of treating the data as purely objective facts about the knowable world in the way that the objectivist approach would require. On the other hand, my previous experience in innovation management and tight participation to the innovation management process gives this study an ethnographic stance also. I was one of the main research instruments of the study.

The grounded theory method used in this research follows closely the original grounded theory by Glaser and Strauss (Glaser & Strauss, 1967). My grounded theory approach is not as purely objective as Glaser suggested (Glaser, 1978). Instead I see the use of grounded theory in more of a constructivist - interpretive way. The researcher is within the process not outside or above it. It is to be noted that in their original statement of method Glaser and Strauss left some room for the researcher to use the method flexibly (Glaser & Strauss, 1967). I have used some of the developments during the past four decades and use as a guide the Charmaz's latest method description of the grounded theory approach (Charmaz, 2006). I examine the processes and have a study of action as central during the analysis.

There are several possible research strategies within the qualitative approach to conduct the research and analyze the data. I used a mixed interview and survey research method with a grounded theory analysis. This approach was selected because it fits well with the researchers' experience and background and fits with the phenomenon under study. It also requires close long term involvement with the phenomenon. The empirical data is approached through several stages, called in this study as encounters, which all focus on separate aspect of the studied phenomena.

3.3 Research procedure

This research journey began in early 2006 with an interest in the relationship between research & development (R&D) and the customer management processes. Customers are in close contact with R&D and product development in the company where I worked at that time which raised the question of studying the relationship in more detail.

Customer – R&D interaction soon revealed the concept of user oriented design, user based innovation and lead users as the paths to follow. However, when I began the data collection I decided to stay at a more general level in order to avoid jumping to conclusion and to ensure detailed data analysis and collection. The concrete research began in late 2006 with the first set of data collection. The first data collection concentrated on innovation management in general.

Interviews were lightly structured and allowed the discussion to flow into any and all innovation management subjects. I was already confident of the need for close relationships with the customer in product development so the first path to follow was innovation and customer relations. This is seen in the first set of interviews. The preliminary coding and analysis of the interviews was done using handwritten notes and transcribed interview memos. Categories at the top of the papers included "customer involvement" and "customer orientation". During the first coding and analysis the unit of analysis was the innovation project. I was trying to understand what was happening at the process level.

The second data gathering was done in mid 2007 with a sample from the second company. The data analysis on the first set of interviews was complete. The same categories were found but also the concept of intuition with the form of “decision by feeling” was raised for the first time. My interest started to shift towards decision making - “How do these decisions actually happen in innovation management?". These first two interview data sets are from the same industry and from the same kind of companies. I felt that I needed to get a broader view and understanding on the subject of innovation management, especially concerning the decisions made at the front end.

The third and the fourth company and data sets are from the telecom sector. At the same time the unit of analysis shifted from the process level to include the individual decision makers in the innovation front end. The third data collection was done in late 2007 with a sample from a third company.

During 2007 the shift in interest and research was moving towards decision making. This is visible in second and third data gathering sessions. I gathered also some more theoretical knowledge about decision making and returned to the field in late 2007.

The fourth data collection was done in early 2008. I concentrated on innovation front end decision making in the interviews and dug deeper in the use of intuition. How the use of intuition reveals itself at the front end, how it is used, what approaches decision makers have in the use of intuition, when it is used etc. However the basic structure or actually the lack of structure is what remained in the interview agendas in order to avoid influencing the responses. The interviews and transcripts for the fourth interview round were the most extensive. Also support of previous findings was encouraging.

During the research I wrote initial memos at all times in addition to interview notes and interview transcripts. Memos started to have more data and form when the data was re-analyzed in each data collection round. During 2008 the first theoretical concepts started to surface and the first encounter with the data from an innovation management perspective was developed and the first drafts on the research results were completed.

The first encounter with the full data revealed the importance of decision making from a fresh viewpoint and sparked a second encounter with a new perspective based on the use of intuition. During the second encounter the same procedures used in writing memos and drafts continued. Late 2008 the first integration of the research results and written drafts were completed.

Since the concretizing of the use of intuition is challenging I felt that more supportive data was needed. I was also interested in studying how experienced and inexperienced decision makers differ in their use of intuition in decision making. I conducted an additional survey questionnaire to verify the use of intuition at an individual – decision maker – level. The survey supported my previous findings based on the interview data and revealed some new viewpoints on the phenomenon under study concerning the experience of the decision maker. At the same time I had a third encounter with the interview data from the perspective of a decision maker using intuition.

The year 2009 was spent in understanding the research results, writing the concepts and drafts and integrating and elaborating the results into a coherent form. The theoretical side to the dissertation was started at this time and the first drafts of the full dissertation manuscripts were done. From 2010 onwards the manuscript with full argumentation was developed further and the theoretical argumentation based on the existing literature was created. From then on phases concentrated on developing the manuscript further with an enhanced discussion, argumentation and conclusion.

The research procedure is visualized in the Figures 3.1 and 3.2.

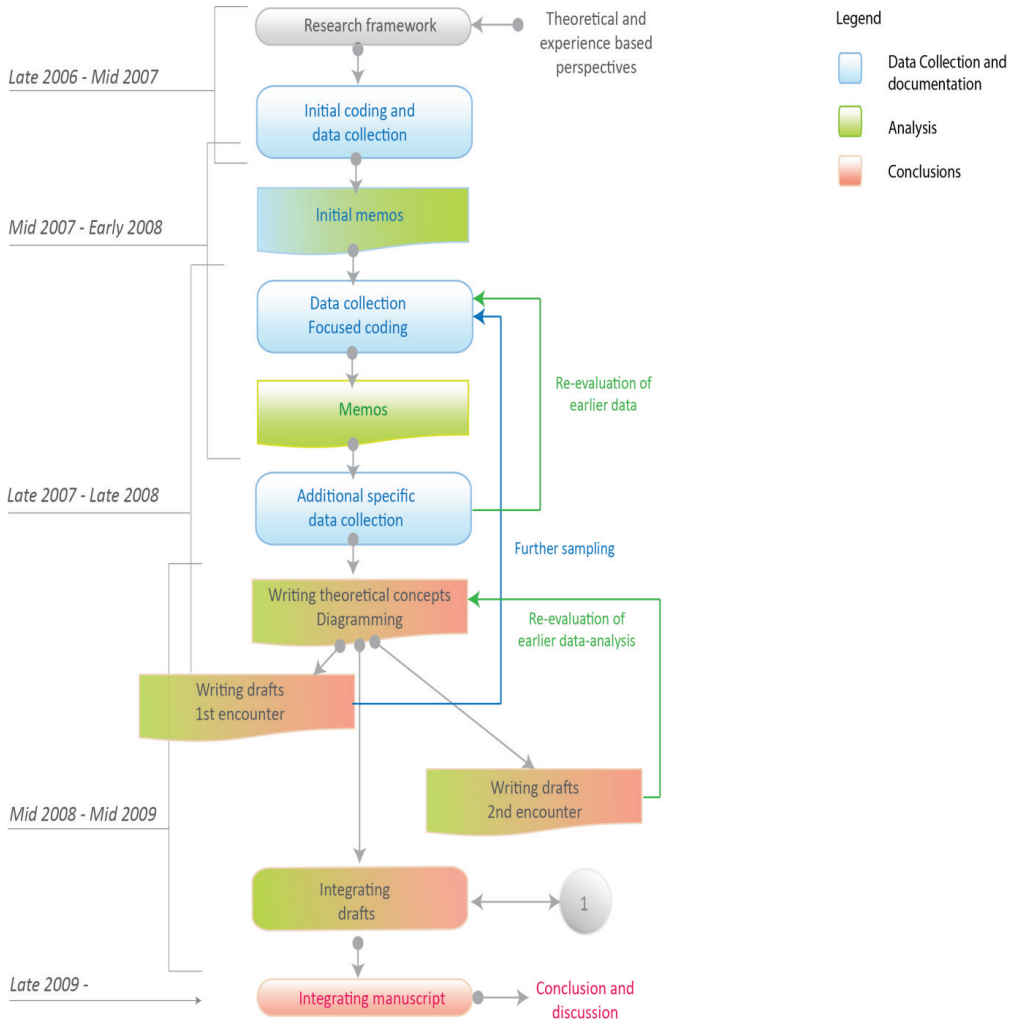

Figure 3.1: Research procedure. Interview data.

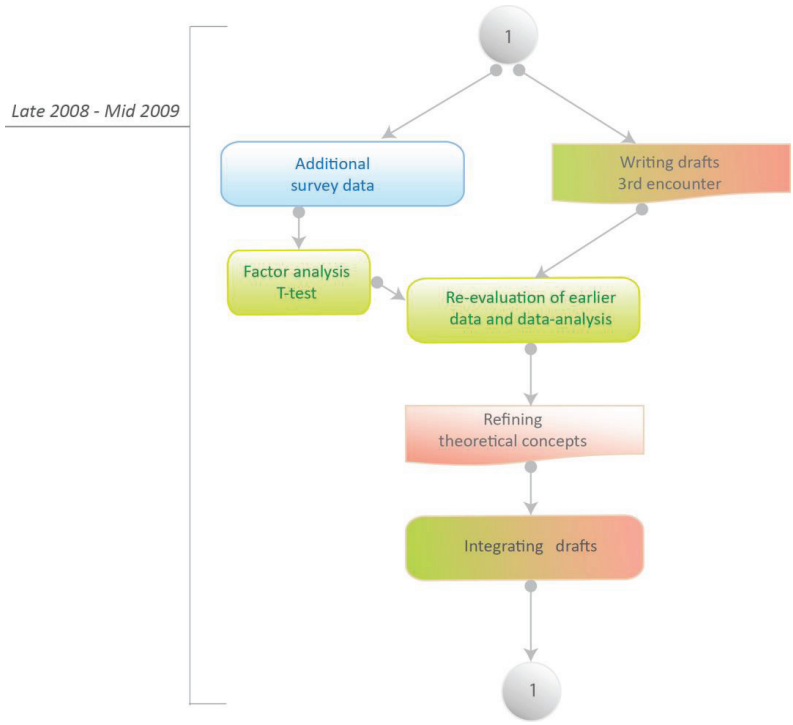

Figure 3.2: Research procedure. Survey data.

3.4 Interview data collection and analysis

The primary data collection and analysis was done based on interview material from 19 experienced decision makers. The decision makers were from four separate ICT companies. The companies were selected as representing high velocity companies with high innovation activities so the data would represent innovative companies operating in rapidly developing environments. It is assumed that the data from these companies provides a good representation of innovative operations since the ICT industry has been judged as having highly innovative abilities over the past few years (Christensen & Raynor, 2003).

The software and telecom industries are typically rated as high velocity industries. This study further enhances the data available about decision making in high velocity companies (Eisenhardt & Zbaracki, 1992). The high innovativeness was rated by looking at the proportion of R&D expenditure related to revenue. Three of the selected companies were spending more

than 10% of revenue to R&D activities, the last of the companies has one of the largest R&D operations in the world and thus can be considered also innovative.

All of the four companies are product development companies. The companies operate in high velocity markets and environments. One of the companies is a Finnish software company, one is globally operating software company and the rest two are globally operating telecom companies. The second of the two companies were selected based on theoretical sampling. In theoretical sampling the cases are selected so that they are particularly suitable for illuminating and extending the studied phenomenon (Eisenhardt, 1989b). The selected companies had to operate in the same industry and operate in new product development. They also should have some similarities in their innovation processes. This poses some limitations on the representativeness and generalization of the research findings but that will remain one of the characteristics of this study.

3.4.1 Company demographics

The first company that was analyzed had a long history as a Finnish software company. The company was established in mid 80s. Currently the company is a medium size international software company (~750 employees in 2008). The company has experienced extensive growth over the past several years. The pseudonym used for this company is Alfa. Alfa develops financial software for purchase to pay processes. The product portfolio is large covering the large part of the process area. Alfa has been a pioneer in electronic invoice handling and delivery in the world.

The second company, named Beta, has also a long history in financial sector software development. The company has mainly developed solutions for handling payment transactions between companies and banks. Later the product portfolio was developed to also include other parts of the financial processes. Beta has a solid track record of high quality software development for the financial sector in Finland. It has basically no revenue outside of Finland. It is a small-medium size Finnish software company (~100 employees). Beta had a very large R&D department accounting for approxi-

mately 50% of the personnel. The company was also tightly process oriented and controlled by an extensive quality system.

The second set of the companies consists of two telecom sector companies. The first one, named Gamma, develops telecom equipment and related software. Gamma is a global company with several thousand employees. It has operations in several continents and countries, including Finland. Gamma has a decades long history in the telecom sector and it has pioneered several data communication innovations globally. Gamma is known from its solid engineering innovation background – technological inventions and innovations. Gamma has successfully transformed itself with the telecom sector transformation during the last two decades.

The fourth company, Delta, is a very large multinational ICT company. It has tens of thousands of employees globally. Company is one of the largest R&D investors in the world. A high level of research and study activities is thus evident. Lots of effort is put into studying the environment, consumers, competitors, technologies and the trends within the industry. Delta has undergone several transformations during its lifetime. The boom of the mobile communications was one of the largest. Delta managed to invent and innovate successfully during the takeoff of the mobile industry and exceeded the innovation abilities of all of its competitors at that time. The company and interview demographics is shown in Table 3.1.

Table 3.1: Company interview demographics

Company	Software	Telco	Empl. Size	# interviews (persons)
Alfa	X		Hundreds	6
Beta	X		One hundred	5
Gamma		X	Thousands	5
Delta		X	Tens of thousands	3
				19

The companies are a good representation of the industry. Even though the software companies are small on a global perspective their operations can be extended to include larger global software companies. The selected telecom companies are fair representatives of global telecom companies. The

representativeness is limited to the ICT industry but can also be extended to other high velocity environments and industries.

3.4.2 Interviewees

The interviewees were selected so that the interviewed persons are well connected to the decision making of product development and innovations. The selection of the interviewed persons was done by asking the company representatives to nominate key persons who could provide insight into innovation management in practice of the case company. The requirement was that the persons had to have been involved in innovation decision making for several years. The company representative was typically in the position as head of product development or equivalent. All of the interviewed persons have a long history with the company they are involved with and they have been in key roles concerning innovation management and decision making.

The demographics of the interviewed persons are as follows (Table 3.2).

Table 3.2: Demographics of interviewed persons

Work experience

	Answer	Count
1.	1-5 years	0
2.	6-10 years	0
3.	11-15 years	3
4.	16-20 years	4
5.	above 20 years	12
	Total	**19**

Years in current organization

	Answer	Count
1.	1-5 years	5
2.	6-10 years	5
3.	11-15 years	1
4.	16-20 years	6
5.	above 20 years	2
	Total	**19**

Highest education

	Answer	Count
1.	Bachelor	3
2.	Master	12
3.	Doctorate	1
4.	Other	3
	Total	**19**

Education discipline

	Answer	Count
1.	Engineering	7
2.	Science/technology	2
3.	Business/management	8
4.	Other	2
	Total	**19**

Current function

	Answer	Count
1.	Engineering	4
2.	Science/technology	1
3.	Business/management	12
4.	Other	2
	Total	**19**

3.4.3 Interview data collection

The interview was selected as a data collection method because the research approach benefited from having direct contact with people intimately involved in the innovation management process. This is a requirement highlighted also by Charmaz (2006). The use of interviews also made possible to steer the data collection in the direction that was of most interest to the researcher. Also the studied phenomenon – intuition or the use of intuition – is vaguely structured and lacks commonly accepted methods and theories and thus the interview data provides the possibility of building theory during the research process. However, the phenomenon under study (the use of intuition) was not known when the data collection method was decided upon.

Interviews were semi-structured – minimal structures were used to guide the discussion inside the innovation management of the case company. No question sets were given to the interviewee nor did the interviewee have to prepare him/herself for the interview beforehand. The interviewees were only aware that the research was on the topic of innovation management. The lack of structure was because the research method calls for early and open involvement in the field to the data. My purpose was also to study how the interviewees see innovation management in practice and the issues related to it without any preconceptions about the purpose of the study.

The first interview in a case company was typically longer than the others. This is because the discussion often followed many different paths concerning innovations and touched on several projects and involved large time scales. I prepared some possible discussion ideas for subsequent interviews based on the first one. Because of this latter interviews were a bit more structured. I took this approach because it helped in taking the right path from the beginning and avoided side steps during the discussion.

In order to guide the interviews in the same direction some basic questions and terms were used. Firstly the term innovation was defined so that all interviewees had a common understanding of the term. Innovation is

defined here in comparison to the idea or invention so that innovation is a commercialized invention as described in the literature review. Commercialization has not to be successful but that had been the target.

Also the difference between incremental, radical and disruptive innovations was discussed. Incremental innovation is in question when something that exists in small steps is developed further. Radical innovation refers in this study to a case where something that had not previously existed is found and developed. Disruptive innovation refers to an occasion where the foundations for innovation are disturbed and changed with something that makes innovations in that area obsolete.

The innovation context of a product, process or business innovation is the third categorization used in the discussions. The interviews were not limited to any previously mentioned categories or definitions, or vice versa. The scope was to discuss freely all kinds of innovations where the interviewee had firsthand experience. However, all of the interviews were about product related innovations.

Secondly the interviewee was asked to provide a list of innovations what they have witnessed in the organization. The purpose was to list the names of the innovations for further discussion. Interviewees were also asked to separate successful innovations from unsuccessful ones. Unfortunately the number of unsuccessful innovations discussed was limited, probably people were not as willing to reveal unsuccessful innovations as they were the successful ones. This is a bias towards successful incidents. People likely do not want their own failure is discussed and criticized publically.

After the previously mentioned basic questions the interviews were continued with discussions about the innovations, the reasons behind their success/failure and the process involved in their development (e.g. how the innovations were discussed, handled, decided on and put forward in the organization). All of the interviews focused mainly on the front end phase of innovations, since the discussions always started with descriptions of how the innovation in question started in the company. During the interviews the critical incident technique was used (Flanagan, 1954; Miles & Huberman, 1994). The use of the technique helped to explore the subject more deeply during the initial interview and in the later interviews. Critical

incidents were incidents that were considered to have had significant importance in the course of innovation under discussion. When critical incidents surfaced the interviews were guided so that those incidents were more specifically discussed.

The basic structure of the interview remained the same in all cases. The discussion topics were as follows:

- Definitions (term innovation, innovation types)
- Examples of innovations: successes, failures
- Reasons behind the success/failure
- The innovation process: Idea generation, decision making, timescales, structures, person's involved, process description
- Innovativeness in general in the company
- Other possible issues

At the end of the interview the background information of the persons were reviewed (work experience, occupation, position, education). I also asked who else would be willing and able to discuss the innovations.

Even though the basic structure of the discussion topics remained the same, the focus in later interviews was more on the decision making context since the data analysis guided data collection in that direction. I did not bring up intuition as a discussion topic in any interviews on purpose. If the interviewed person mentioned the use of intuition then I guided the discussion in that direction.

Since the use of intuition came up during data analysis I wanted to be careful not to force the data towards the use of intuition. It would have been very easy to start to discuss the use of intuition in decision making, but that would have – in my opinion – guided the data too much. By remaining open to the innovation management process discussion I was able to be sure that the data is as clean as possible. The only change between the structure of the first interview and the structure of the later ones was a focus change towards a decision making context.

The interview data consists of 19 interviews with the length from 1 hour to over 2 hours, with the average being 1.5 hours. All the interviews were recorded and transcribed. Transcriptions were done by a second person (i.e.

not the researcher). Transcriptions were 7 to 19 pages in length, the average being 12 pages. Altogether the transcribed and analyzed interview material resulted over 200 pages of written data.

3.4.4 Interview data analysis using grounded theory approach

The interviews were recorded and transcribed as described earlier. Transcripts were pure non-edited text. Before the coding I corrected the transcripts for punctuation mistakes, terminology misunderstandings and coded the paragraphs by the interviewer prefix (#H) and the interviewee prefix (#Yxz, where xz represents the number of the company =x and the number of the interviewed person =z). The transcriptions were also converted to rich text format for use in the data analysis tool.

The transcribed interviews were treated as accounts describing the innovation project where the individual person has been involved. The analysis process tried to identify different elements and their relations inside innovation management and the decision making process based on how interviewed persons had seen it happening.

I started to code the data based on the "what is happening" – action. I did only very limited initial memo writing during the first round of data analysis. In practice I started to write memos during the second round of coding with the help of a new tool. These memos could also be called as narratives describing different cases within the innovation process. This helped to categorize the data and analyze it throughout the memo writing.

During the first encounter and analysis phase I treated the original transcripts of the interviews as narrative descriptions of the "life in a company's' innovation project". I coded the texts based on activities in the process (open coding). An activity based coding was selected because I wanted to explore the process of what is really happening in innovation management and that can be probed by looking at the activities. After each text analysis I linked the new codes to existing ones if possible (focused coding) and wrote initial memos describing the possible relationships and findings of that interview as they related to the previous data and findings.

The initial coding was done on a sentence level, not a line-by-line or paragraph level. I selected the sentence level since it was appropriate for getting ahold of the real action. Line-by-line would have been too detailed and paragraph level would not have found the separate actions inside one paragraph. I coded based on “action” to get a grasp of the processes and what is happening in those processes.

At that time I realized that the tools I was using to analyze the data were not sufficient to keep the data in order and to make further analysis based on coding and categories. It was at this time that I started to use the ATLAS.ti (ATLAS.ti, 2006) tool. This meant that I had to recode all of the material using ATLAS. I tried to use the same basic coding I used during the first coding and analysis round, because I wanted the evolution of my research and thought process to be visible. Naturally some changes were made to the coding, because of easier and more flexible ways of working provided by the ATLAS tool. Going through the same material revealed some new insights into the two first data sets, which were not visible before. These are described in later sections.

During the coding I cross-checked the transcribed text with my own notes which I had taken during the interviews and added some notes to the initial memos which I wrote simultaneously. Usually I coded two interviews at the same time, one after another, and compared the observations and codes between the two interviews. The purpose was to follow a procedure called the constant comparative method as described by Glaser & Strauss (1967). Naturally the coding started with open coding, but after the first interviews I started also to use codes from the list when I found similar to those discussed before. Also some *in vivo* codes were used. When applying an *in vivo* code, the selected text itself is registered as a quotation and used as a code name.

Since I had to code the first two sets of interviews once again after changing the analyze tool, my second coding round which I did for the same data with the new tool, already resembled focused coding. The thought process which was used during the manual - pen and paper - initial coding was not visible the second time. I had however taken these ideas into the initial memos which I wrote during the second coding round.

I started to write memos and narratives immediately with the second coding round. I also wrote some notes directly into code explanations in order to grasp the extended meaning of the code and the possible connections on the spot. After the analysis of the first company I started to build networks of codes and memos. The networks were first built up very rapidly just to establish the possible connections between the different ideas, codes and concepts on the paper. From the very beginning I used a flip board extensively to clarify the ideas on the paper and have them visible to keep my thinking focused. The walls of my study sometimes had so full of flip board pages taped to them that nothing else was visible. Continuous flow back and forth with the transcripts and codes was done regularly to keep the code base viable.

After the fourth interview round I did the first full encounter with the data. That was the most extensive analysis during the whole research period. As a result the three main categories emerged. Out of the three core categories, one of the core categories - decision making - was selected as the core category for further analysis.

The second encounter with the data focused on exploring the decision making context in innovation management. The second encounter was done with “intuition glasses” on. The grouping of the codes and the categorization was done by looking at the data from an intuition point of view. It resulted in four core categories to describe how the use of intuition reveals itself in front end decision making.

The third encounter with the data was done based on the roles and properties of the roles that use intuition in decision making. The matrix where codes and interviews were presented was used to categorize the roles. From the matrix the most significant codes were highlighted and an approach for describing which decision makers use intuition (role descriptions) was formed. These were used to describe the properties of different roles.

In order to make sense out of the data I followed several qualitative data analysis tools to support the research process (Miles & Huberman, 1994). From the beginning of the research I started to draw diagrams showing the relationships and connections between the codes and categories. This helped to further the analysis of the new interview data. During the data

analysis process lots of cross-tabulation tables were used to uncover patterns or "code concentrations" as a seed for core categories. Extracts from the interview data were used to support the data analysis process and to make the results of the analysis process more transparent to the reader. The use of these methods is made visible in the results chapter of this study.

3.5 Questionnaire data collection and analysis

3.5.1 Questionnaire data description and collection

Secondary data collection and analysis was done in the form of a survey questionnaire in order to get more support for the use of intuition, to verify the findings from the interview data analysis and to answer the third research question. I also judged this to be important since I needed more evidence for the use of intuition in decision making.

The first sample in survey questionnaire consisted of 19 interviewed persons – the interviewees (experienced). 18 responses were received. The second sample consisted of managers with little or no experience and experienced specialists. The purpose was to get a sample of decision makers with little experience in innovation decision making. All the persons in the second sample were selected from two of the interviewed companies, companies Alfa and Beta. This was because access to the other two companies was limited.

The second sample consisted of 93 persons. The response rate with the second sample was 73% (68 persons) (Table 3.3). The number of total respondents to the questionnaire survey was 86 persons (Table 3.4).

The survey was conducted using the web-based tool. Participants were invited to the survey by email where the link to the web form was posted. The survey tool allowed persons freely to answer the posted questions, however respondents were required to answer all questions. Response time varied between 211 and 8331 seconds.

The survey of the interview group was posted on the 5th of November 2008 and closed on the 16th of April 2009. Despite of the several reminders one person did not respond to the survey. The survey of the second group

was posted on the 13th of February 2009 and closed on the 18th of April 2009. Two reminders were sent to the participants, which only slightly increased the response rate.

Table 3.3: Demographics of the control group (inexperienced decision makers)

Work experience

	Answer	Count
1.	1-5 years	4
2.	6-10 years	18
3.	11-15 years	17
4.	16-20 years	14
5.	above 20 years	15
	Total	**68**

Years in current organization

	Answer	Count
1.	1-5 years	42
2.	6-10 years	23
3.	11-15 years	3
4.	16-20 years	0
5.	above 20 years	0
	Total	**68**

Highest education

	Answer	Count
1.	Bachelor	27
2.	Master	34
3.	Doctorate	0
4.	Other	7
	Total	**68**

Education discipline

	Answer	Count
1.	Engineering	18
2.	Science/technology	19
3.	Business/management	20
4.	Other	11
	Total	**68**

Current function

	Answer	Count
1.	Engineering	16
2.	Science/technology	12
3.	Business/management	36
4.	Other	4
	Total	**68**

Table 3.4: Demographics of the whole survey group

Work experience

	Answer	Count
1.	1-5 years	4
2.	6-10 years	18
3.	11-15 years	20
4.	16-20 years	18
5.	above 20 years	26
	Total	**86**

Years in current organization

	Answer	Count
1.	1-5 years	47
2.	6-10 years	28
3.	11-15 years	4
4.	16-20 years	5
5.	above 20 years	2
	Total	**86**

Highest education

	Answer	Count
1.	Bachelor	30
2.	Master	45
3.	Doctorate	1
4.	Other	10
	Total	**86**

Education discipline

	Answer	Count
1.	Engineering	25
2.	Science/technology	21
3.	Business/management	27
4.	Other	13
	Total	**86**

Current function

	Answer	Count
1.	Engineering	20
2.	Science/technology	13
3.	Business/management	47
4.	Other	6
	Total	**86**

Decision makers were well represented in the selected sample. All of the inexperienced decision makers were selected as part of the target control group. They had all have recently received a managerial or chief engineering related position which requires decision making. Even though they were not all directly involved in innovation management, they all worked in the engineering organization.

The interviewed persons were regarded as experienced decision makers based on their long experience in the decision making concerning innovation management. They have all been working for years in positions close to innovations that require constant decision making. The response rate (73%) is also high which further supports the representativeness of the selected sample.

3.5.2 Questionnaire and variables

This study (the analysis of survey questionnaire data) applies the existing research instrument and measurement constructs to study intuitiveness.

The validity of the constructs is evaluated and reported in the results chapter of this study.

Intuition and the use of intuition was further studied in this study using Cognitive Experiential Self Theory (CEST) developed by Epstein (Epstein, 1990, 1994). CEST proposes that there are two information processing systems which people use – experiential and rational. Those systems are independent and operate by different rules. CEST includes intuition as a part of an experiential system that is contrasted with an analytical-rational system. However, CEST indicates that both systems contribute jointly to behavior (Epstein et al., 1996).

The measure instrument for intuition developed by Epstein et al. which is based on CEST is the Rational Experiential Inventory (REI) (Epstein et al., 1996). The REI consists of rational and experiential subscales which are each divided into ability and favorability subscales. The ability scale estimates a person's belief in their own ability to use experiential or rational thinking. The favorability scale reflects a person's preference for engaging in experiential or rational processing. I used the long version of REI (Pacini & Epstein, 1999) for this study. The long version consists of 40 Likert-scale questions, 10 for each subscale (rational ability, rational engagement, experiential ability, and experiential engagement). The survey questions are available in Appendix B.

There are several other instruments that are also available which can be used to measure the use of intuition. Allinson and Hayes (1996) developed another self-report inventory, the Cognitive Style Index (CSI) to locate people based on a uni-dimensional, bi-polar information processing concept. The validity of CSI has however been found to be deficient in recent studies (Hodgkinson & Sadler-Smith, 2003a, 2003b). There are also instruments like the Affect Infusion Model (AIM) by Forgas (Forgas, 1995) or the Agor Intuitive Management (AIM) survey by Weston Agor (Agor, 1989b) which have a different way of studying the use of intuition. The availability of these different instruments shows that there is still a mixture of instruments available which all produce a different view of intuition and its use in decision making.

I selected CEST and REI because REI has been found to be one of the available instruments which sees information processing as based on two separate but parallel systems (which is in accordance with the definition of intuition in this study). REI is also widely used and readily available. REI has been criticized by Hodgkinson et al. (Hodgkinson et al., 2008; Hodgkinson et al., 2006) but I found it unnecessary to develop a totally new instrument for this study. REI will sufficiently support the purposes of my argumentation. For a detailed explanation of the CEST and REI refer to the Epstein, Pacini et al. (1996).

3.6 Questionnaire data analysis

The statistical tools used to analyze the construct validity and survey results were factor analysis and t-test. The 40 items from REI were entered into a principal component factor analysis with varimax rotation. A scree plot was used to verify the explanative power of the factor solution selected. The t-test was used to verify that there were no statistically significant differences between the interview group and control group. The results are elaborated upon in the results chapter of this thesis.

3.7 Validity, reliability and the researcher's role

3.7.1 Validity and reliability

I used triangulation by data type and by research method to improve the reliability and validity of this study and to support my findings in the interview data. In addition to the interview data a separate survey was conducted. For the survey instrument, one of the most well-known and widely used decision making self-evaluation tools - REI (Rational Experiential Inventory) was used (Epstein et al., 1996).

How to assess the validity and reliability in qualitative or quantitative survey research differs significantly. The appropriateness of the measurement instrument used in a quantitative survey can be assessed by first evaluating if the measurement instrument is measuring what was intended to measure (validity). Secondly by evaluating to what degree a re-measurement using the same instrument would lead to the same results (reliability)

(Bohrnstedt, 1983; Nummenmaa, 2004). The reliability and validity of the survey was evaluated by a factor analysis and by calculating Cronbach's coefficient alphas for the measurement items.

There is a long standing belief in psychological research that human judgments are less accurate than statistical ones (see e.g. Goldberg, 1970; Meehl, 1954, 1965). Human judgment and related biases have also been researched a great deal by e.g. Kahnemann and Tversky (Kahneman et al., 1982; Tversky & Kahneman, 1974). The qualitative research was evaluated using the criteria presented by Charmaz: Credibility, originality, resonance and usefulness (Charmaz, 2006). These criteria are in line with general evaluation criteria for the qualitative studies presented by Miles and Huberman (Miles & Huberman, 1994).

The qualitative research that I have done in this study is about making judgments based on the interview and survey data. The analysis and judgments made by a single researcher are always subjective and only questionably reliable. This can lead to false interpretations or at least a different analysis than another researcher would have produced. I have tried to avoid this by being transparent in how I ended up with the conclusions what I did. My methods are explained in the method and data analysis section and in the results section. This should help the reader to follow my thought process, and leaves my logic open to scrutiny.

I selected the first companies where the interviews were held based on their software engineering background. This selection limits the representativeness of the data. In order to improve this, two other interview companies were selected that were not purely software engineering companies, but were on the telecom engineering side. Even though this slightly improves the representativeness of the data, it is still limited to engineering type of companies. All the companies and their projects in the data were also limited to new product development.

The interviewed individuals were selected partially by myself, partially by the company contact person and partially based on recommendations from the first interviewed persons. I asked the first person I interviewed to recommend one or two other people who had thorough knowledge about innovations and innovation management in the company and who could discuss

those topics. The purpose was to find people who had enough experience in innovation management. However, there is a risk that the recommended persons might share the same opinions and status as the person who recommended them. This is referred to as an *elite bias* or *representativeness heuristics* (Kahneman et al., 1982). I believe this to be a relatively rare case.

When the interviews started, the interviewees were assured anonymity. This was to get people to speak more freely about their experiences and about confidential issues. This anonymity is preserved in the study. Only the researcher can access the raw data and the outsider cannot connect the data to single employee of the company in question. This is accentuated since the interviewees were selected during the research process, not by the research setting. The companies from which the interviewed persons were selected are also treated anonymously. The anonymity of the companies is also preserved as much as possible. They can however quite easily be deduced based on the professional background of the researcher.

The interview structure and the questions remained basically the same during the all interviews. The interview questions were very open ended and allowed the discussion to explore all areas of innovation management. During the latter interviews an effort was made to steer the discussion towards innovation decision making as is typical with this kind of research method. Based on the first interviews, it became clear that decision making was the path to follow.

It has been noted that intuitive judgments are best studied if the research design minimizes the possibility of self-critical reflection and deliberation (Kahneman, 2003b). This research design with its openly structured interviews and no pre-arranged intuition focus follows the advice offered by Kahneman. The role of intuition only became apparent to the interviewed persons during the survey questionnaire phase. At that time all of the interviews had already been conducted.

It has to also be noted that the focus on intuitive judgment was not known to me when I started the research journey and selected the research approach and method. Only during later phases of the data analysis phase did I realize the appropriateness of the method.

3.7.2 Researcher's role

I started with a data first approach as described in chapter 3.2. Data collection started in the middle of my obligatory post graduate studies. That is to say that I already had some theoretical grounding at the start of the data collection but for the most part stayed as close as possible to the original idea of the grounded theory research. Since I had spent so many years in the industry, I did not have any existing academic practice or background theory available.

I started gathering the data openly by just trying to understand what happens in innovation management, what are the basic processes and how do the processes and actors operate. This revealed to me new avenues in innovation management even in a company where I had worked for several years. The early start had some disadvantages too, since I had to learn about data collection and analysis methods at the same time. This resulted in a re-coding and implementation of a new tool for the data analysis after the first two data collections periods. This may have had a negative effect to the validity of this study. However, I was aware of this potential problem in advance and I tried to avoid it during the analysis period.

The research has also some ethnographic elements because my work related to innovation management as a head of software production at the time of interviews. I was closely involved in product development. I had been involved in every decision concerning product development innovations at the company from late 2003 to late 2008. Later on I was also involved in innovation strategy level decisions. This of course has some effect on the way how I interpreted the interviews and how there were a possible source of bias in my analysis. I have tried to be as open minded as possible, but this is one of the limitations of this study.

On the other hand, I have a much deeper understanding of the innovation process in practice than does the normal researcher. It can also been seen as an advantage since I was familiar with the context and the phenomena to some extent from the beginning of the research. That provided me with the possibility of finding and interpreting the kinds of issues that may have otherwise been left unfound in the process. In this way the research data is more profound and richer.

4 Results

"It is not the strongest of the species that survive nor the most intelligent, but the one most responsive to change"

Charles Darwin

In this chapter the results of this research are presented. First the empirical data used for the research is presented. The selection of the case companies and the interviewees are described in the research method section of this dissertation. After the presentation of the empirical data, a detailed description of the grounded theory development of this research is presented in order to give the reader the possibility to evaluate the research process and development of the results. Next the quantitative research part of the dissertation is presented and finally a synthesis of the research findings is developed.

4.1 Company descriptions

4.1.1 Company Alfa

When the company Alfa was established, the business focus of Alfa was not in the software business, instead Alfa's main business was consulting with 3rd party software. When the technology shift happened from mainframe/mini computers to personal computers (PC) it greatly affected the whole software industry. The financial software sector (where the company operated) started to shift towards PC based financial software.

One of the main points of Alfa's business was to concentrate on building packaged software and productizing it with the customer.

> *"When we managed to get some revenue from the product licenses, we believed that it pays back to start the productization of the software in addition to pure customer tailored software development. It is more sensible to sell the same stuff many times than to do tailored project deliveries. There is more profit potential."*

The basic differences and rules between consulting based tailoring and packaged software based licensing was a key item in the company strategy. This was a clear business model selection. As a small, owner financed company, all of the product development work had to be done as customer paid development, because no outside financing was in place to afford long term product development projects without cash flow into the company. This also meant that all of the products developed with the customer were not productized. Only the ones which seemed to have larger user potential were productized.

> *...we did a customer tailored application and when there was more demand we decided to productize it as an official product. The decision was made because of demand from several customers. We already had good relations with key customers from the 80s and many new customers also. We had good contacts in the financial management of customer companies.*

What was the reason to concentrate on the software business instead of the consulting business? It could have been the educational background of the company management. All of the key people in the company had a degree in economics. At that time there was already some software business education in place in universities. However, since there was little experience or research on the software business, much of the decisions were based on feeling.

> *I think that the business decisions were done on the spot – not to analyze the background information too much.*

> *Case by case decisions. The market demand was certainly the primary reason why to productize and also my own thoughts that this could be a good idea … it was a feeling based decision.*

The importance of complementary knowledge and common understanding was of vital importance in company Alfa. There was no-one in the team that was clearly more powerful who could always make the final call, rather the paths forward and decisions were made together. Certainly the most technically competent persons had a louder voice for technical decisions and also vice versa in other areas of the business.

The first clear change in the course happened when the market for one of Alfa's main products declined in Finland. There was suddenly a need to develop business into new areas. The first version of financial management software was built. Necessity makes you try hard and innovate since you need to survive.

> *…There was competition in the market…Basic reason could be the economic situation and the down turn of the markets…Consultation revenues dived. That was the compelling force.*

The innovations that Alfa created (which are discussed in this study) happened mainly in late 1990s when the company had already moved into the software business.

4.1.2 Company Beta

Alfa and Beta have many similarities in their operations – they are approximately in same age, they have grown with same speed up to early 2000s and they were both software companies developing software into financial processes. However, they have some differences which are highlighted below.

Productization of the software was even more of a focus in Beta than in Alfa:

> *They (the customer) were given an offer and they paid for the work done. Applications were ready and fulfilled their requirements. We didn't do any tailoring, instead we had all the time clear that this has to be productized and suitable for other customers too. I had this in my agenda personally but it was in other people's minds too. Maintenance revenue was the key here.*

Individual decision making was clearly emphasized in this company. Even though the discussion of the management team was important the final decision was made by the CEO. Management control was tight. This is seen in many comments:

> *Together we discussed and started the development project, but [person] surely made the final decisions.*

People involved in decision making – or discussions - changed from time to time. This was probably done on purpose by the CEO in order to get fresh ideas on the table. The decision process itself did not have a clear structure. Instead it seems that the decisions were made when the timing was right for making a certain decision. This almost resembles garbage can decision making (Cohen et al., 1972). However, it was effective way of making decisions in the company.

Technology played a key role in product development decisions. Also, a clear process structure and simple processes were on the focus. Products were developed starting with a small feature set and then enhanced gradually after the first part was stabilized.

> *(the products) are based on that very simple basic idea…That we were planning it from the customer's point of view. What the simplest possible process to solve this problem is and how can it be implemented by the software. This is the thought process behind the majority of our development projects.*

4.1.3 Company Gamma

Gamma operated in the telecom sector. The development of telecom equipment required a tight interconnection between hardware, integrated circuit, embedded software and management application software development. Projects were typically large and also long in duration.

The development was connected to inventions and company Gamma was also active in the patenting arena. However, most of the innovations came from customer ideas and Gamma further processed those ideas into innovations. The search for innovativeness was almost institutionalized in the company. New ideas were discovered based on competitor analysis, keeping up to date with market trends, from customer input and also by internal analysis.

> *Then there are those cases when we have started to think about what does not work well. Things that could potentially have a lot of value for the customer but that do not work well at the moment. We have systematically started to analyze the situation.*

They had noticed that innovation required the right personal attitude and support from the organization otherwise it was very difficult to nurture innovativeness in the company.

> *Inventing and innovation is an attitude question. You need to have a supporting infrastructure for that in place…You need to have an inbuilt attitude towards innovativeness. It is dependent anyhow on individuals, the pride and desire to invent new things, so that in the middle of all that daily hassle one still tries to put forward these things.*

> *Innovation can have two directions. First, we have a problem and it needs to resolved, that resulted innovation. Secondly, when have a ready solution but we don't yet know the problem. These can both be good!*

Clearly an “engineer attitude” was driving innovation in the company “we have a problem, lets’ solve it”. Technology driven innovation was visible “we have a good technology available; let’s find a problem that it solves”. In the interviews the problem solving attitude was brought up by many of the interviewed persons.

> *It is the problem itself…Every engineer knows that when you do things it goes from solving one problem to another. It is really problem solving – the real engineering work…If there is not this attitude in individual minds we are not going to survive…*

Competition surveillance was also one area of inventions or ideas for the innovation. When you see what others have done to solve a problem, you might get a better idea of how to solve the same problem or a new idea to solve a similar problem elsewhere.

In totally new development and in a search for radical innovations the risks of unsuccessful projects are high. This company mitigated the risk by having clear back-up plans. This required the possibility of putting extra resources into R&D and innovation projects.

> *In some cases it could be beneficial to try and fail and try again to get a good solution finally. You need to have that space for trial and error, so that if something really fails…Yes we have back-up plans. Sometimes in very comprehensive ones too [like competing R&D projects]…*

4.1.4 Company Delta

Delta produced telecom products for mass consumer markets. In innovation and development co-creation with the community was highlighted. Delta had mobilized a widespread innovation community both internally and externally.

> *This is how we mobilize the whole society and ecosystem where we operate to co-operate transparently with and for us.*

The large size of the company and its R&D department provided it with huge muscles which could not be compared to any of the previously interviewed companies. Its large size also brought some challenges in the form of organizational and communication problems which build some overhead in the organizations efficiency. Alfa and Beta operated in a totally different world when compared with Delta and their innovation operations. However, all three companies had been successful in innovation year after year.

Decision making was not based on pure rational facts when the decision touched on unknown, uncertain cases.

> *When we set-up a project we have to think about how the business model affects the case. Do we have a clear model, do we have an end user, what he does he want,…It is more or less based on gut feelings at that time.*

Still clear criteria existed which limited the decisions made based on "gut feeling". Clear themes guided the whole operation.

> *It was the [theme]. It is based on the experience of how people lead others. That was what they realized during the years…Some clear theme needs to be established, that helps you manage the whole thing. Clear theme guides and manages almost by itself.*

The importance of a common vision and a commonly understood theme was regularly highlighted by the interviewed persons. Delta was such a big company that it needed to had some common elements which tied the company together and built a feeling of togetherness, because otherwise organization and operations could have torn the company apart.

4.1.5 Summary: Innovative companies

All four companies can be regarded as innovative if you look at them from a R&D expenditure, product portfolio, industry requirements or simply a history track record perspective. Some of the companies are more on the technological innovation side, like Gamma, and some are more on the technology and user/consumer goods side, like Delta. All of the companies have example cases from incremental and radical innovations; some of the innovations can be described as at least partly to be disruptive. This is the case when totally new business models or application areas were formed. Most of the innovation activities in these case companies are related to new product development or process innovations although some of those can be categorized as also having paradigm level effects.

None of the companies are young start-up type companies – they all have reached mature age in their businesses. However, Alfa and Beta are small companies if compared to Gamma and Delta.

Innovation management practices in the companies vary. This is probably because of the size, industry area and age of the companies. The telecom industry is environmentally strictly regulated (standards) and this certainly has an effect on innovation management practices. Processes, including innovation management processes, need to ensure that the necessary standards are met and that the results can be clearly reported to the authorities. The operating environment of all of the companies can be described as a high-velocity environment. Technology changes and customer expectations are in constant change and the companies have to respond to those needs and changes in a rapid way.

The organizational structures of large companies are typically deeper than in smaller ones. This is also seen in these case companies. Heavy organizational structure added to a strict process culture can stiffen the organization and reduce innovation activities. This was not seen in this group of companies. It could be said that even the largest company has very vivid innovation practices, but how that is done is different than in the smaller companies. Gamma and Delta have established clear processes for taking into account all of the relevant parties as a means to

foster innovativeness. In Alfa and Beta the close internal relations and proximity with the key customers naturally ensures innovativeness.

Notable is that the process cultures in Alfa and Beta are very different. Beta has developed and follows certified quality management procedures, whereas Alfa has a lightweight process approach. This does not affect on Betas performance or innovativeness in a negative way.

The roles of individuals in all companies seem to be equal. There are visionaries and workhorses in all companies. The specialization of work roles is taken further in Gamma and Delta. Alfa and Beta have more "all-round" persons, people with several roles and responsibilities. This is quite natural because of the size of the companies – specialization comes into place when the company is larger.

The decision making practices are related to the process and organization structures of the case companies. Despite the clear structures and responsibilities for example in Beta and Gamma, the decision making was sometimes done by by-passing the official path. A sign of lobbying and political decision making was noticed in many descriptions of the interviewed persons.

4.2 First encounter with the data: Decision makers' experiences of innovation management

The first analysis of the data was done by coding the data by activities and actions regarding innovation management. All 19 interviews were included in the data. The most grounded codes were connected to customer orientation (customer orientation, productizing with customer, commercialization importance, productization of the knowledge) the second group included codes like decision by feeling and group decision making.

After the first encounter with the data, the core categories that emerged were: Innovation enablers, compelling forces and decision making. Innovation enablers and compelling forces could further be associated with innovation. For innovation to happen you need to have

innovation enablers and compelling forces. Both are needed in order to have a basis for innovation to succeed. When innovation is possible it has to be decided what to do. The decision process has several different properties which are described in the network figure in Appendix B and in the following chapters.

4.2.1 Innovation enablers

Innovation enablers are the basic prerequisites that are needed in order for innovation to be possible in the organization. Based on the analysis in this study enablers are not enough to make innovation successful, but without them innovation is impossible. Enablers are like the foundation of a house. Innovation enabler categories reported in the following chapters are: *Customer orientation, productization with the customer, a clear way of working, complementary knowledge, enabling technologies and keeping up to date with trends*.

Customer orientation

The most frequently mentioned grounded code recognized by the interviewees with regard to innovations was *customer orientation*. Customer orientation leads most of the development activities. A customer typically has a problem which needs a solution. That leads a customer oriented company to innovate new solutions. Clear customer orientation and productization with the customer also has had a direct relationship with the successful and unsuccessful innovations.

> *We have been close to customers and listened to their issues and thought together, that has been the way to solve the cases. From and with the customer have we started… We delivered the solutions to the customer and learned how they operate. We found out where the biggest problems were, the development needs.*
>
> *…was developed first without the customer. There was a strong growth orientation. We didn't handle the development process correctly, the customer was not close enough…Customer had the different view on the subject*

than what we had. That's why the … path has been so difficult.

Productizing knowledge is different than productizing with the customer. The former means that the company may have the knowledge but it is not necessarily tested with the customer before the productization is done. In this case – as noted earlier - there is a higher risk for unsuccessful innovation.

We tried to recognize the situation and create a new application, productize and sell it. The commercial side dived. We did the product which did not have demand on the market.

There are also negative effects on customer orientation. Since commercialization is so tightly connected with development it has a tendency to reduce research and thus hurt the innovativeness of the company.

Everything needs to have a commercial justification. That is the direction nowadays…how can you then innovate something new…

Productization with the customer

A company needs to be technology oriented by nature in order to be able to use or apply new technologies in innovation. This is a prerequisite and one of the innovation enablers. In order to productize with the customer you need to have something concrete to be productized. That something can be a technology or product idea which will bring value to the customer. Company's own core development makes it possible.

we have a customer who pays it … then it was just a question as to what we can do with it so that it can be productized to fit with other customers too…

… we start in the customer's world and think about what could be the best solution what we can offer it to serve the customer's needs…

Productization with the customer is probably the only way a company like Alfa or Beta can move forward. These companies must first sell one idea and one product to the first customer, get the financing from that deal and then if possible commercialize it and also deliver it to other companies. It is remarkable that the business model of the software business was all the time dominant in discussions with Alfa and Beta even though the business started with consulting and tailoring the software. The bigger the companies grew the more the emphasis shifts to the software business (i.e. license revenue).

Clear way of working

One of the innovation enablers is a *clear way of working*. A good simple process structure clarifies the basic procedures in the company and in innovation management. This provides the opportunity to concentrate some effort into innovating activities.

> *The process with which we in [company] did these things was well developed. We had a good structures e.g. for prioritization…We think that things are in surprisingly good shape in our operations. This helps discussions and synchronization. This can be reason why everything seems so self-evident*

Clear way of working relates also to personal interfaces inside the company. Everyone can work together productively and everyone knows how to work together. Team commitment to innovations is highlighted in many interviews.

> *We were shaking because of the energy it gave to us*

Clear way of working also relates to internal product structure so that you have clear ways of working with the products produced. This means for example interfaces and other product architectural things between different units of the products.

Complementary knowledge

There are innovation enablers such as *complementary knowledge*. They are the fuel to spark the new innovations. When there are different viewpoints on the discussion over the same problem novel solutions or proposals might arise. These could not have been raised if only one solution had been put forward. If the group is composed of different kinds of people with different kinds of professional backgrounds and a knowledge that fosters innovative thinking and innovations you can create an environment with good complementary knowledge.

> *...the core group what we first had we all had some kind of knowledge of financial management but also of individual strengths either in management, technologies, organization design or business management.*
>
> *We created a cross organizational taskforces where technology experts together with experts from the marketing and customer side worked together in workshops*

Enabling technologies

The *enabling technologies* category consists of codes: technological innovations, flexible technologies, technology shifts what are happening, applying new technologies and compelling technologies. It is a category which is a combination of all technology related codes which influence whether innovation is possible.

> *We saw that when Windows had a breakthrough in technology side it gave us new possibilities*
>
> *At that time Internet came fast and it could be said that it was the reason for the whole development project we launched*
>
> *We wanted that [technology] to be open, so that it could be sold to anyone*
>
> *...different solutions which were not optimal for the customers at that time, but could have been solved much better with this new technology*

> *There was a change in legislation which made the electronic archiving of invoices possible.*

Usually it is understood that the technological advancement is the most important factor in new innovations. Based on what interviewees said this is not the case. This is addressed in the other categories presented in this study.

Keeping up to date with trends

Keeping up to date with trends includes activities like influencing in the standardization bodies, seminars, professional article browsing etc.

> *You get the inspiration sometimes just by following what happens in the standardization bodies, sometimes inspiration comes directly from customer needs, sometimes when competitor is revealing their solutions… It is based on your experience or the way you see the trends in the market.*

You need to understand the information and be able to apply the knowledge to what you get from those sources in order to keep yourself up to date with trends and other developments in the industry.

4.2.2 Compelling forces

People and companies need compelling forces to do the necessary decisions and actions. Necessity is often the mother of invention and decision makers threatened with failure often discover ways to cut costs, produce better products and market them more effectively (March, 1994). If there is not yet enough pull available from the market then the necessary pressure needs to be created intentionally. The compelling forces categories which are reported in the following chapters are: *Changing business environment, competing in the market place and commercialization.*

Changing business environment

One of the most powerful forces is change in the business environment. If you are to survive in a changing business environment you need to invent and develop new businesses. This is even more compelling in companies which are relying only on their own cash flow without outside financing.

> *When that business ended we started to do build the same functionality by ourselves with other tools…In the 90s the supply did not meet the demand in the market. We were figuring out what to do now.*
>
> *It was from the sales and marketing where we got the first indications that the market might be developing positively in that area.*

The *changing business environment* category is closely connected with the *keeping up to date with trends* category which was described in the "innovation enablers" core category. The *changing business environment* is grouped under "compelling forces" because it is by nature more compelling than *keeping up to date with trends*, still they both have the same kinds of attributes.

Competing in the market place

Competition in the market place is the second powerful force motivating companies to innovate.

> *The product was developed because of the competition in the market. We had to do it, otherwise the competitor could have said that we don't have the same functionality as they do.*

Companies need to be aware what happens in the market place at all times. It is a continuous fight against time pressures and required functionalities. Entry into the market is usually very time critical. If you are late in launching new innovations, the market may be taken by the rival companies.

> *We had a unit which was up to date all the time about what was happening in the market.*
>
> *To be late means that we came out approximately at the same time as the big players in the market. The game is lost at that point.*

Markets are not at the same level regarding the competitive situation. The ICT market is a high velocity market where the competition is tough and changing rapidly.

Commercialization

When a small company grows, commercialization always plays a key role. Everything that you do you have to be able to sell. There is no additional financing available for these companies. The importance of the commercialization is especially high in Alfa and Beta since all the operations have to be financed by incoming cash flow.

> *We are not going to develop the product for the shelf but for the customer. Sales have the best contact with the customer... You have to keep in mind all the time the commercialization aspects.*

Duplicating software relates to *commercialization*. It is one of the fundamentals in the packaged software business. You develop the core software once, package it and sell it to many customers as a readymade packaged solution.

> *In the organization there was an understanding that by productizing and commercializing good ideas we can grow fast...Duplicability was what we wanted to achieve.*

Keeping it simple helps in developing packaged software. It is also a process issue. When you keep your processes simple and clear you work efficiently without additional overhead costs in your operations. That is again one of the fundamentals in successful business.

> *Eventually it originated from the thought that we want to build such an application that it could be delivered by one click.*

If you are to get business from the software market, you need to get the commercialization done as easy and as fast as possible. The easier the software is to install, the better the revenue potential from the product, because of the increased predictability of the implementation projects and the higher the volume in the license revenue base.

4.2.3 Decision making elements

The third core category after "innovation enablers" and "compelling forces" is "decision making" related codes and categories (Figure 4.1). In innovation management, after the groundwork for innovation has been laid (innovation enablers and compelling forces) decisions need to be made. Categories under the "decision making" core category reported in the following chapters are: *Decision by feeling, decision by analysis and individual and group decision making*. *Decision by feeling and group decision making* were the most grounded codes under "decision making" core category.

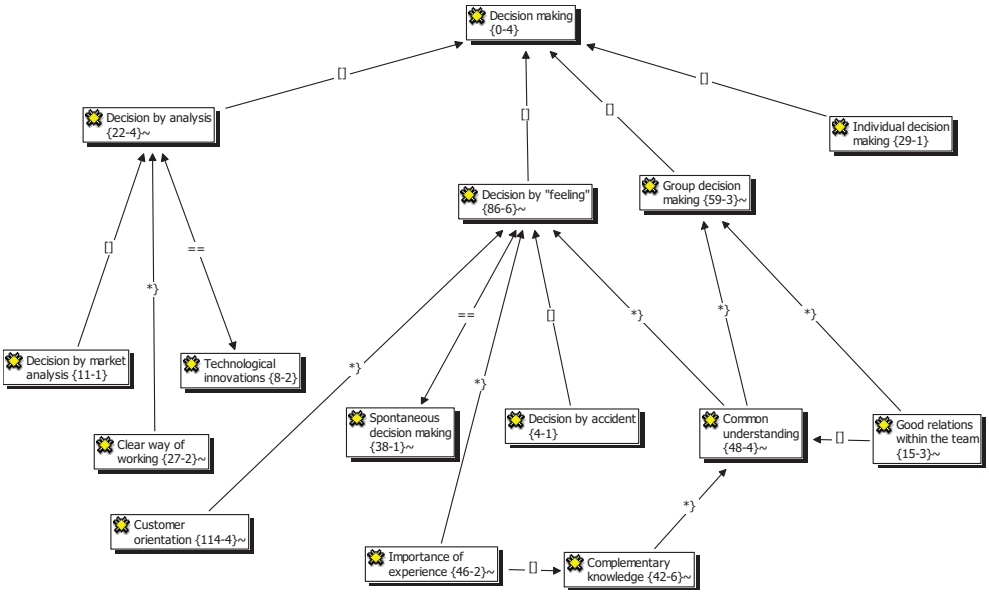

Figure 4.1: Network of codes for decision making

Decision by feeling

Decision by feeling is reflected in many comments from all of the companies. Sometimes the decisions were made during unofficial occasions like coffee table discussions and sometimes the decision was made on the spot, very quickly.

> *This decision was made because it just felt like that…There is a good process in use which produces things what you don't even recognize.*
>
> *…we were a small company and the decision making was very simple. We didn't need any analysis because it looked so clear and straight forward.*
>
> *It just came up and we decided to start to implement it like that…In one way or another we have always had that insight that the feeling has to be strong that this is needed.*

In order to be able to make the decisions by feeling you need to have experience in the market, technologies and especially from the customers. Decision by feeling is like how a nurse cares for a patient. You just know the subject and area so well that you know by heart what to do.

> *There are many guiding ideas which help you to go forward and you don't even think about those. They just seem so obvious. When you are so tightly connected to that it is almost same as your values.*

Decision by analysis

Decision by analysis is related to a *clear way of working*. If you have systematic ways of doing things (processes in place), you have the possibility of making decisions by analysis and you are making the decision constantly using the same framework. Market and competition analysis is just one example of the tools used in decision by analysis approach. In company Beta the emphasis to clear and strict process culture was especially evident in the interviewees' descriptions about innovation practices in the company.

> *It is then again the decision making process. We have studies and gates, it is the accepted product creation process. It goes on quite analytically…I don't know if it is that special, but we try to listen to the sales and customers and then in co-operation make the decisions.*
>
> *You can go on with facts when you have that kind of environment where you know the basic rules … it is based on the criteria that we have.*

Individual and group decision making

It is noted that decision processes where steered by one individual in one of the companies. This is because of personal properties but also because of the size of the company. It is natural that in a smaller company the decision making was very simple and follows the individual decision process. When the company grows in size, decision making becomes more complex and multiple actors are involved in the process.

> *There wasn't too many others whom to discuss with. I made the decisions.*
>
> *He was very often the final decision maker.*

Group decision making was highlighted in rest of the companies. It was visible in un-official discussions as well as in official decision making bodies. The bigger the companies are the more important the cross functional planning and decision making becomes.

> *...we decided that we will start to develop application to this. We had kind of subconscious vision...It was a common mind.*
>
> *It was these development meetings where we had participants from sales, r&d, implementation...the list of issues that we prioritized and selected the best for further planning. Then the management group decided what to develop.*
>
> *...more people always to decide those things which were somehow binding. But the discussion was really very democratic.*

4.2.4 Summary after the first encounter with the data: Innovation decision making

The emerged core categories after first encounter with the data analysis were “innovation enablers”, “compelling forces” and “decision making”. “Innovation enablers” came up as a natural category because the interviews were about innovation management. The discussions easily moved into paths describing what made the innovations possible in these companies. All of the companies built an offering into the marketplace, so it is natural that *customer orientation* and *working with the customers* was raised as a key code in the data analysis.

“Compelling forces” are needed in addition to enablers to push the initiative further. Usually the needed push came as a result of the competition, changes in the market or some internal necessity to act. I felt that the interesting topics concerning “innovation enablers” or “compelling force”s had been fully explored. Instead “decision making” – how decisions are really made – had more interesting topics to explore further.

The core category “decision making” was analyzed further in more detail. The “decision by feeling” code/category and the sub codes like “spontaneous decision making” were noted in the majority of the decision making descriptions. That guided how the analysis looked at what is happening in those situations.

Decision by feeling was highlighted in the vast majority of decision making occurrences. Eighty six (86) of the quotes were coded as decision by feeling whereas only twenty two (22) quotes were coded as decision by analysis. Decisions usually happened by accident or spontaneously without deliberate reasoning. This indicates that there are a large portion of non-analytical decision makers in these studied cases.

Another clear observation was that most of the quotes were related to group decision making and the minority to individual decision making (59/29). This further indicates that decisions concerning innovations are more often done in group decision making situations than by individual decision makers. It does not explain how an individual on a team ended up making a decision which was then brought up in the group decision making situation.

After reading and analyzing again the quotes related to the “decision by feeling” code/category the use of non-rational decision making elements raised my interest, because of the high number of occurrences of the codes. One of the non-rational decision making elements is the use of intuition in decision making (see chapter 2.1.3). That was the target for the second encounter with the full data. A matrix of the most appeared codes is available in Appendix C.

4.3 Second encounter with the data: Facets on using intuition at the front end of innovation

The second encounter with the data was done by reading and analyzing again the transcribed data and coding it from a different perspective. This time the coding was done by looking for occurrences describing or linked to the use of non-rational – intuition related - decision making elements purely, rather than for activities or actions as was done in the first encounter. By selecting the new angle for the analysis of data I

aimed at getting deeper into the selected core category and the phenomena and looking at the data from a fresh perspective. This is very important since there is always a danger of getting stuck on the first perspective especially if it relates directly to your profession.

The first categorization during the second encounter with the data resulted to four core categories: “Symptoms”, “preceding enablers”, “simultaneous enablers” and “safeguards”. The interviewees expressed that the decisions must “just get done” – spontaneously and based on the feelings. These expressions where categorized under the core category “symptoms of the use of intuition”. The use of intuition in the decision making process requires that basic preceding enablers supporting intuition are in place. Decision makers explained that there has to be some order in the decision making process and that you have to value intuition as a decision making tool. This resulted in the category “preceding enablers”. Many interviewees were found to be very enthusiastic about their profession and their duties. Their approach was like an explorer finding new ways to navigate across the seas. These qualities include lowering the barrier that prevents you from using your intuitive abilities – the category was named “simultaneous enablers”. Some of the interviewed persons described that they were able to immediately test their decisions in the form of a pilot or other direct feedback. Expressions related to testing the intuition were categorized under “safeguards” for the use of an intuition category.

These four emerged core categories are explained in more detail in the following sections. The coding of the quotes (CxPy: Company x Person y), as seen in later chapters, is used to preserve the anonymity of the interviewed persons, but also giving the reader the ability to follow the researchers thought process and to evaluate the process.

4.3.1 Symptoms of the use of intuition

Symptoms are the expressions and codes which indicate that intuition could be affecting the decision making event in the case. The interviewed persons on many occasions described their decision making as being made partly based on feeling. The categories reported are: *Decision by*

feeling, spontaneous decision making, unconscious vision/seeing, individual thought process, decision by accident and non-decisiveness.

Decision by feeling

Decision by feeling category as described in section 4.2.3 belongs to this category. Decision by feeling surfaces in cases where there may not be any special reasoning behind the decision that was made. The interviewed person had a feeling at the time of decision and the decision got made. They are also not saying that intuition was used to guide the decision; instead some other expressions are used. Typically a person could not articulate what lead to the decision or why it was made. Decision by feeling does not mean that the person had a good feeling at the time of decision but that the decision was made simply by relying on what felt right. Interviewees also described that in some cases the feeling did not appear immediately; instead it took some time to mature.

> *I have an opinion that business decisions have just been made so that there is not too much thought process – there is just the situation at hand and we had to figure out what to do. We didn't go very far to analyze the backgrounds etc. the decision points just came. Decision was certainly one driver as to why we started to develop and certainly also our own idea.[C4P6]*

Spontaneous decision making

Spontaneous decision making describes the event were a decision gets made rapidly without deliberate, at least not recognizable, thought process. It did not require long discussions or descriptions. Unofficial undocumented discussions or meetings could have preceded the event. Interviewees described this way of acting as a natural way of working in the company, a simple method for making decisions.

> *The decision was made by me and [person] – I think. Probably the final say came from [person]. It [decision] just appeared and we decided to start doing it like that. It*

> *was the decision what we saw as necessary at that time even though we had no clue at all as to whom we would sell it to later on [C3P2].*

Spontaneous differs from *decision by feeling* in the speed of the decision making. There might have been some unconscious thought process or maturing phase in the background but in spontaneous decision making these forces are not recognizable at all. A sudden spark or a light bulb going on describes a spontaneous decision making incident.

Unconscious vision

Unconscious vision relates to a common understanding code. Unconscious vision was reflected by many of the interviewees in one of the companies. Seeing was another description of the same phenomena.

> *When we were dealing with [subject and subject], we had the main elements in place even though that was new way of doing those things. Suddenly we saw that there could be a seed for a [product]. No one else had it at that time. We knew that it is worth trying. [C4P2]*

Seeing or unconscious vision highlights the appearance or existence of some vision or view. The decision making incident itself could have been fast or slow but some view or vision was found to be present at the time. Vision was described by interviewees having group characteristic – not a single person vision but a common group vision.

> *We just had a common vision of the case [name]. Because of that we ended up doing what we did. [C4P1]*

Individual thought process

Individual thought processes related events were described in such a way that the interviewee had a thought which guided the decision process. Thought is not clear or firm as a vision, but more of an unstructured vague idea. Often it was also described as individual thought, not as a common view or vision. This category is similar to the *decision by*

feeling category. However, this is not as comprehensive as it was with *decision by feeling*.

> *I just had that thought…that fitted to my thought process…it comes as a leading thought [C3P1].*

Decision by accident

When the decisions happen by accident and the feeling is that the process is just drifting forward was described by many when was asked to describe how the process actually went forward. The interviewee described no clear structure for how the decisions were made, instead that was a gradual process of maturing and formalization.

> *Well – at first it was just an idea. An internal idea. In a way we could not concretize it at that time as well as we probably should have. It was just an idea that we should somehow be able to do [solution description]… Then at some stage it just started to concretize into that form that we started to sketch the solution on the paper…the decision matured their time [C3P4].*

When the decisions happened by accident the interviewees realized afterwards that the decision was really made at that time. During the incident it was not recognizable. Accidental decisions became visible during the later phases of the process and at this point it became apparent that the actual decision had been already made.

Indecisiveness

One kind of indecisiveness can be understood as a sign of intuition. Indecisiveness is closely related to decision by accident but indecisiveness has a clear active component of indecision.

> *In my opinion there was not really much decision making in those cases…[C4P1]*

It is deliberately noticed that there was no willingness to make the decision however it was later realized that the decision had already been made earlier. *Indecisiveness* is also related to *drifting /decision by accident* in a kind of flow which just takes things forward. *Indecisiveness* just has the active – indecisive - part with it.

4.3.2 Preceding enablers

When the interviewees described their actions they highlighted the need for some basic structures and shared values – regardless of the use of intuition in the final decision. These elements are categorized as "preceding enablers". Preceding enablers are needed as a basis for the intuition to be used during the decision process. The categories in the preceding enablers are: *Values, clear way of working/processes, knowledge and discussion*. Without these preceding enablers it is not possible for intuition to surface – there is no support for it. Preceding enablers are elements of people's behavior, the existing conditions or processes.

Values

One of the necessary prerequisites – preceding enablers - for the use of intuition is that the person or the group values trust or support towards the use of intuition. If they do not believe that intuition is a valid construct in the decision making process then intuition is not trusted and is not used. When the importance of the values is discussed, the interviewee stressed the importance of common goals.

> *It is from experience, it is my values. It is a combination of all these facts, values and feelings. It is something so deeply grounded that you cannot change it… We had such a strong belief on it…everything is just based on it that you and the team believes in it…very strong commitment to it. [C1P1]*

Values and trust take long time to develop and institutionalize in an organization. It is the same with intuition. New organizations or groups are less capable of using intuition in their decision making than older –

more mature – ones. Typically the incidents where values and trust were mentioned came from the groups who had worked together for years.

Clear way of working/processes

Intuition needs a solid grounding as a basis. If everything is a mess there is no support for the use of intuition. In chaotic environments decisions get made using irrational basis (Aaltonen, 2007). Several interviewees from the same company described the importance of clear structures and processes as a basis for their innovation work.

> *First the basics has to be in order…very strong process culture…We had a good templates for prioritization of activities…at least some systematic in those activities…[C3P1]*

Organizational routines and processes build the fertile soil for intuition to be used. If there is no order at all and the decision processes are in chaos then there is nothing that the use of intuition can be attached to or linked to.

Knowledge

Knowledge works in the background of the decision making process where intuition is used. Without it, intuition cannot function properly, however this is not simple heuristic. Heuristics and intuition are closely related, but heuristics can typically be applied to predefined patterns of actions whereas intuitions cannot. The interviewees often described the existence of knowledge as the *importance of experience*. *Complementary knowledge* relates to the same code in that if you have complementary knowledge within a team or group of people you do not personally have to have all the knowledge in your possession.

> *It was the knowledge which made the spark…it would not have worked if there had not been so many experienced persons…[C1P2]*
>
> *We had the knowledge inside the organization…there was experience, we had been doing before the same kind*

of exercises…we brought the cross-functional experience to the process…[C1P3]

Knowledge or experience of course requires time to develop. That is why it is only available in mature groups or organizations with more acquired knowledge. The interviewed persons all had a substantial background as decision makers in innovations and thus the experience they had gathered was comprehensive.

Discussion

A rich discussion culture is needed to get people to share ideas and knowledge and use intuition more easily. In informal discussions, many ideas were put forward without the need for more formal meetings or decisions. Even though some interviewed persons mentioned the role of individual decision makers they all recognized the importance of discussions - official and unofficial.

We had many common discussions – and the decisions just happened…the group actively discusses…it was a kind of brainstorming what we had…the group just discussed about it….[C4P3]

It was kind of brainstorming all the time. People just threw the ideas. Then we tuned it further. How did we then select the best one? Well - let's say that those were the best ideas which somehow wake you up. [C2P2]

Discussion culture nurtures the change of ideas and knowledge which in turn builds appropriate grounds for the intuition to be used. A discussion culture also builds trust and anchors values into the organization, which were some of the already mentioned preceding enablers.

4.3.3 Simultaneous enablers

The interviewees who clearly used intuition (because the indications were highly visible) in their decision making had additional qualities that made it easier for them to use intuition. These qualities are more per-

sonal in nature than the preceding enablers. They also worked more closely on the decision making incident itself. I named this core category "simultaneous enablers". Categories of simultaneous enablers are: *Courage and enthusiasm, imaging and discovering, and final push and creativity*.

"Simultaneous enablers" are the qualities which are required even though the "preceding enablers" are in place. If the threshold for the use of intuition is too high intuition is not used even though the preceding enablers are there. Simultaneous enablers work in favor of preceding enablers and lower the threshold for the use of intuition in decision making. It is difficult to distinguish between the" preceding enablers" and "simultaneous enablers". I judge the preceding enablers to be more important for the use of intuition than the simultaneous enablers. This is because without the preceding enablers the use of intuition lacks a basis to work from. Without the simultaneous enablers it is just unlikely that intuition will be used.

Courage and enthusiasm

You need to have enough courage to trust your intuition. In some cases people are afraid to reveal that the basis of their decision was intuition. Instead they try to formulate the decision based on logical reasoning. As self-confidence develops, trust in intuition also grows.

> *It was the common way of working – not that much more analyzing. We had knowledge of those things but the tools were at that time deficient…courage was the trump there. We made a lot of compromises afterwards. Meetings were everybody involved was participating. [C4P3]*

Enthusiasm for the case at hand lowers your intuition threshold. Strong enthusiasm is seen in cases where there are very enthusiastic – vigorous – persons who put all their heart and soul into the project.

> *Typically they are exceptional enthusiastic…you have the pride and willingness to innovate new things. With all the other rush duties you try to put forward new innova-*

> *tions…There has to be someone who personally drives the case forward. If there is enough value to you personally you will put it forward. I believe it is much connected to your strong will, and you nurture it with discussions and open culture.[C2P1]*

When you are very committed to innovation and putting all your efforts and energy to it, also develops your self-confidence and that way lowers the threshold for the use of intuition.

Imaging and discovering

Imaging is a way of looking forward in the innovation process. When you are able to imagine possible outcomes and results, the decision process is easier and lowers your barriers for the use of intuition. The clear vision of the future also guided some of the interviewee's decision making. The interviewed persons figured out how to proceed by thinking about possible future paths.

> *We started to think about productizing. We had knowledge about to make good use of. Knowledge was widespread, not only in [area] but also in other disciplines. We did some small market studies and also customers gave us ideas. We thought about technology developments and had brainstorming sessions about the future.[C4P5]*
>
> *The first discussion was around Spring…We started to figure out what could be the solution for the future. At that time internet was hype and that was the basis for the imaging…all the possible solutions were considered. [C3P3]*

Vivid imagination combined with the aforementioned "preceding enablers" is very strongly correlated with the lowering of intuition. When coupled with *enthusiasm* it creates a positive flow to the whole process of innovation.

The nature of the explorer or discoverer - "to go beyond the last frontier" – is the quality which is found in many interview instances. When

you are discovering something new there is no previous knowledge or information available and you rely on intuition. The stories told by the interviewed persons provides a feeling of a exploring the nature of innovations.

> *We were discovering it and then we thought it over and understood that what these changes really were. In that way it started to take form. I think I wrote the first specifications and then we started to implement it. [C3P4]*
>
> *It is the problem itself. Every engineer knows that when you innovate you go from one problem to another. That is the real engineering work – the problem solving work. Sometimes it then grows to something really new and big – and then we have innovations. When there is something that is not in line with the existing knowledge then it that is worth of exploring further. Those could be very valuable. Those are no self-evident nor fast things to discover – it takes time to mature. [C2P1]*

Discovering is also at the very core of innovativeness, which is what innovation really is; the discovery of new areas and cultivating the findings into something new and valuable.

Final push and creativity

Some of the innovation enablers work closely with the process where intuition is used and some are more distant. Sometimes a final push is needed to go forward and use the intuition in the process. Creativity and sensitivity to intuition are closely related to the intuitive process.

> *Together we found out that…then we started to understand…we sought and thought together…ideas were thrown in the air…*
>
> *the persons who can seek and then take those up to discussion…when we then figured out that this is it what it is all about…[C2P2]*

It is the ultimate trust of your own ideas and feelings that gives the final push – called a "child-like belief" by one interviewee.

> *It was crystal clear for us that if it had worked once it will work again in other circumstances too – it was just plain child belief. None of us had experience and knowledge to say that it could work, but we just stated let's do it. [C4P2]*

4.3.4 Safeguards

All of the interviewed persons brought up in one form or another the importance of testing their decisions before going too far along the selected path. Those interviewed persons who were more connected to technical product development mentioned the use of prototypes in early phases of the innovation process. Those individuals who were closer to the customer interface highlighted the immediate customer feedback in a form of a pilot customer or clear customer orientation in the development process. I marked this core category of codes as "safeguards". Safeguards included the categories: *Testing, prototyping and inside sponsor*.

Testing and prototyping

Safeguards make the use of intuition easier since it provides a fast way of probing and testing the intuitive decision leading to the correct direction. When there are safeguards available, the feedback is fast and accurate and people are more willing to trust their initial intuition.

> *I saw it so that there was no time to think too much. We started from the scratch…lots of different things to take into the design. Very fast decisions had to be made. Of course we then made prototypes and commented those, with close colleagues and customers…[C2P4]*
>
> *We innovated and combined things in innovative way. Why we were so successful was that we built up an extremely short path from the customer. The path from cus-*

tomer to development. We were able to respond market needs with extreme flexibility. [C1P3]

Testing and prototyping (sometimes called piloting) are the common tools in the innovative processes. They are typically used to get immediate feedback from customers or users. In that way they also act as safeguards for the use of intuition. Confidence in intuition is stronger if you know that whatever happens you are not going to be off track because the earlier the feedback – the smaller the mistake, the easier it is to recover from.

Inside Sponsor

Some of the interviewees told that a sponsor inside the company eases the innovative process. A sponsor can be also categorized as a "safeguard". When there is a person sponsoring the project or the idea that smooth's the way and removes the need for extensive justification for the decisions taken. This is important also because when the decision is made with an intuitive basis, there is no bullet proof justification available.

Safeguards work in favor of "simultaneous enablers", since they lower the threshold for a person to use the intuition. It is the timing difference in the process which makes them their own group or domain. Safeguards are there to be used when a decision is made and a path is selected. "Simultaneous enablers" work before the decision to help you to use intuition in the decision making process.

4.3.5 Summary after the second encounter with the data: Four facets of intuition frame

Use of intuition in innovation management shows up from different facets as was described in previous chapters. This can be considered as a new knowledge in the intuition and innovation management research. The interviewed persons all pointed out different aspects that made the building of the frame possible and how intuition reveals itself in innovation front end decision making. Some of the interviewed persons talked directly about the use of intuition but others did not mention the word

"intuition" itself. However, in all of the interviews there were clues that helped to categorize and formalize the frame of intuition use in decision making.

Four core categories (called as facets) were raised based on the codes from transcribed interviews as described in the previous chapters ("symptoms", "preceding enablers", "simultaneous enablers" and "safeguards"). Symptoms are the signs which signal that intuition may have been in place during the process. The use of intuition is not necessarily visible in the first place. That is why you have to create markers to make the use of intuition visible. Symptoms are to mark whether intuition could have been used in the decision making process. By tracking symptoms the use of intuition is operationalized in the process.

There are preceding enablers that are required for intuitive decision making. Preceding enablers are organizational-level structures or processes which are needed in order to have an "intuitive support" set-up in place. Without preceding enablers the use of intuition is not impossible, but clearly less likely. Simultaneous enablers are closer to the use of intuition in the decision making process. They are more environmentally connected. Preceding enablers and simultaneous enablers both work in favor of the use of intuition before it is used.

Safeguards are there to test the results of an intuitive decision afterwards and provide immediate feedback to the process. Safeguards are also, as preceding enablers, organizational level items. Safeguards work as a single element used to embrace learning and reflect on decision making.

Intuition as a phenomenon is a complex issue. It shows up in very different ways and the interpretation of the use of intuition is always subject to criticism. The following Figure 4.2 paints the frame how the intuition was portrayed in the interviews and how it is used in the empirical data of this study. The connecting lines roughly show the relationships between the different domains inside the phenomenon. The figure is not to be interpreted as a cause-effect diagram with arrows showing causal relationships or event-state diagrams as such, rather it is an illustrative description of the codes and categories from the interview data with the

connections between them. It is a combination of a cognitive map and an event-state diagram (see e.g. Miles & Huberman, 1994).

What the interviewees did not discuss during the interviews was the cases of false intuitive decisions. This is a clear deficiency. The people and cases studied were originally targeted to also include material from unsuccessful decisions. However, during the interviews the interviewees talked briefly about the unsuccessful cases and the interview data material remained limited. That prevented a comparative analysis between the successful and the unsuccessful cases and decisions.

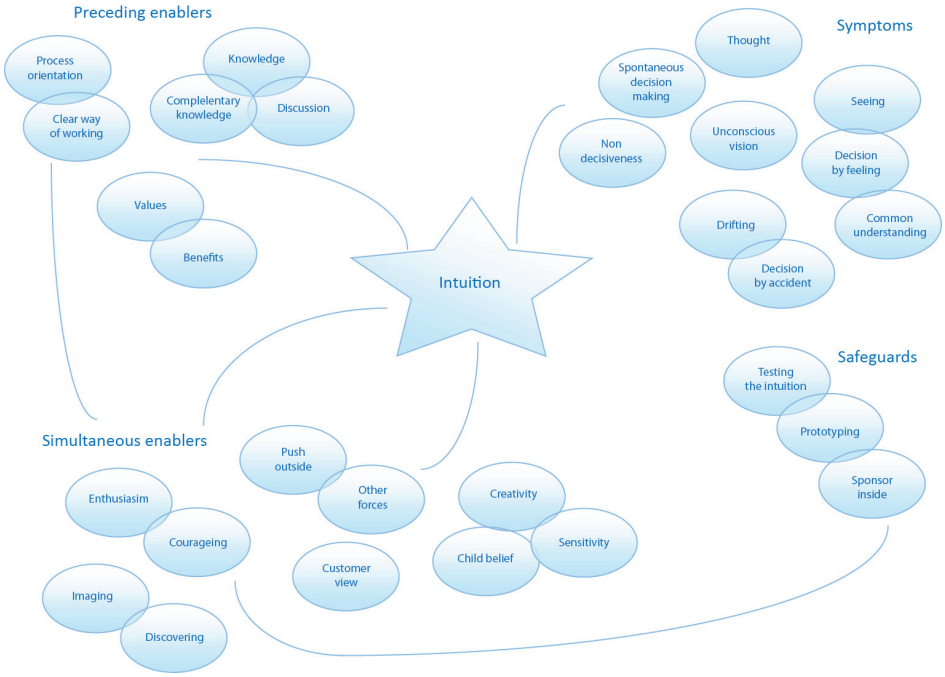

Figure 4.2: Illustrative figure of the use of intuition - "Four facets of intuition frame".

When the frame for the use of intuition in innovation front end was built, the next question was what role did the decision makers play in that process – what was their approach in using intuition. That question guided the third encounter with the data which is reported in the following section.

4.4 Third encounter with the data: Alternative approaches to decision makers' use of intuition

The third encounter and categorization was done based on the approaches and roles of the persons using intuition. Intuition emerged as a guiding core category during the first encounter and was revealed more in the second encounter with the data. During the third encounter I decided to take a more detailed look at how the use of intuition appears in the interviews of experienced decision makers. The different descriptions the interviewed persons provided about the decision making occasions made me curious about how intuition is visible in different roles. Even though the decisions were not solely done by the interviewed persons (group decision making), the persons who explained how they made the decisions or ended up to their conclusions.

The written role descriptions do not have any common structure since the highlighted characteristics varied between the different role descriptions. The descriptions have been written to describe what approaches the interviewed persons took in relation to their use of intuition in decision making. Some direct quotes have been taken in with the text to better explain the characteristics and my reasoning behind the design of the role descriptions.

The descriptions are not exact copies of the persons interviewed. Instead they try to emphasize the dominating qualities of a role when that person uses intuition in decision making. They are more like narratives about experienced decision makers and their use of intuition. There is always an interpretative element in writing these narrative role descriptions – as is always the case in qualitative research. Some individuals have also been placed in two roles, because they have qualities relevant to both.

The names used in the role descriptions are fictitious and not related to actual persons interviewed. All the fictitious names are male, even though there were women in the group. This is to secure the anonymity of those interviewed.

The basis for the role descriptions was done by selecting the most frequently appearing intuitive related codes into a matrix together with the

interviewed persons (persons are coded as C4P1, C4P2,... to preserve the anonymity). Eleven of the most frequently appearing codes and the nineteen interviewed persons are shown in a matrix in Table 4.1. The role descriptions were done based on the Table 4.1 and by taking into account the original transcriptions which were again analyzed and recoded.

The emerged roles were: Drifter, thinker, negotiator, tester, discoverer, believer and seer. I categorized the roles based on the number of occurrences of the codes appearing in the interview as well as my thought process for the most descriptive naming of that category (role). The order of the role descriptions as presented here follows no priority or other logic. I wrote them based on the order of appearance during the analysis process. These roles or categories are explained in more detail in the following sections.

Table 4.1: Most appeared codes per interviewed person (CxPy).

	Values	Imaging	Discussing	Testing	Enthusiasm	Drifting	Knowledge	Visioning	Believing	Seeing	Discovering
C4P1										x	x
C4P2							x				
C4P3						x					
C4P4											
C4P5			x								
C4P6		x									
C3P1					x						x
C3P2										x	
C3P3		x									
C3P4						x		x			x
C3P5											
C2P1					x						x
C2P2		x					x			x	
C2P3											
C2P4			x						x		
C2P5											
C1P1	x			x					x		
C1P2											
C1P3				x							

4.4.1 Drifter

Mike is a person who goes with the flow – he is a drifter. He is silent in group decision making and does not have much of an opinion over the decision process as a whole - “the decisions just happened”. However, Mike feels that the decisions were correct and he would have ended up with the same decisions by himself. Two drifters were identified in the interviews.

The use of intuition in Mike’s case is supportive. He relies on the intuition as he drifts with the process. Probably a drifter does not even recognize the use of intuition.

> *That way it started. What is the innovativeness here is that there were many of those things which just fitted together. We floated away with the process flow. [C4P3]*

The interviews revealed two types of drifters – active and passive drifters. A passive drifter is part of the team and goes with it. He emphasizes group decision making importance and common understanding – he is a consensus seeking person. As in most of the cases customer orientation and productization of the knowledge is highlighted in his way of decision making. Decisions just happen spontaneously.

Mike has a lot of experience in what he is doing. He has stayed for years in a similar kind of position and a similar role. Mike really knows the substance. As a passive drifter Mike does not raise his opinions for discussion, he rather keeps quiet even though he has solid experience and strong subject knowledge.

> *It was the commonly accepted way of doing things, there was not that much thought behind it. We had knowledge and that kind of application was not available. I Think [person] had the lead in it. I felt I was not that excited about it.[C4P3]*

So why is Mike a drifter? One reason is that he is so used to the way the company operates that he does not see any point in making changes. In this way, Mike is a profoundly committed company citizen. It could also be that Mike has had enough and he does not really care how things go. This is however not the case with the two identified drifters.

Sam has more active role in drifting – he is an active drifter. Sam is part of the team but emphasizes the importance of individual decision making. His own thoughts play an important role when he discovers the path forward. Active drifting is highlighted by his way of proceeding - learning by doing.

> *At some stage of the process just started to concretize…We started to seriously put something down on the paper as a form of a specification. I wrote the first specifications and then we circulated them within the team.[C3P4]*

Sam has an active role in the process but he still drifts with the flow – he does not take active role in guiding or steering the process forward. An active drifter is much more talkative than the passive drifter.

Sam takes the lead in bringing issues to the table for discussion. He collects all of the ideas, actively keeps up relationships with colleagues and gets his voice heard in meetings. But that is where he stops. He does not guide the process forward, instead he relies on the process itself to move things forward. In the decision making he notices more clearly the presence of intuition than does the passive drifter.

> *We just get the feel of doing [product] in that way… it was more like a gut feeling – with the discussion.[C3P4]*

Why is Sam an active drifter? Mike and Sam share some qualities - long work history, solid competence. They are drifters because they feel comfortable as such. They do not want to take the lead and step up to a new role. Their use of intuition is based on their high degree of competence resulting from their education and experience. They are not willing to step out from their comfort zone and take an active part in guiding the

process forward. Sam is an active drifter probably because he is more extrovert than Mike.

4.4.2 Thinker

Thinkers are knowledge based and on-the-job learners. Knowledge based individuals gather knowledge and emphasize the importance of experience in the decision making process. Three thinkers were identified amongst the interviewed persons.

Keith has a lot of experience he uses in his decision making to guide his thought process – he is a thinker. Keith seeks complementary knowledge to support his knowledge and is eager to productize knowledge with the customer. He gets complementary knowledge by engaging himself actively in co-operation with internal and external parties.

> *You get the inspiration from standardization forums, from customer requirements, form competitor offering etc. Then you think it forward up to a conclusion and find out that – wait a minute – is this really now processed enough to get the best solution. [C2P5]*

Keith has also experienced failures and has learned lessons from them. He has his "eyes open" all the time and he actively promotes new ways of seeing things. Keith has lots of ideas and uses intuition as he goes forward with the customer.

> *All the time we discussed and weighed the different options… we were professionals in that area and at the same time very close to the customer. We have been able to sketch fast what is needed. Everybody tells a bit differently what is needed, but still they want the same thing. We massaged the ideas, together with the customer in the workshop meetings. Gut feeling takes us forward. [C3P3]*

What makes Keith a thinker is that he highlights the importance of ideas, thoughts and the thought process connected to cultivate those –

imagination. A high number of discussion oriented meetings with common thinking – brainstorming – guides his actions. The group where Keith operates shares the same vision – even though there are sometimes very conflicting opinions about how to realize that vision. All the people are experts and have strong opinions about their own area but at the same time recognize and respect the other experts' views.

> *There were many persons with very strong will in the meetings…the competence areas however were not overlapping – that was the salvation of the whole process. [C2P2]*

Keith proceeds cautiously and likes to have some back-up plans to cover his back. He uses his imagination – intuition – more often when he has other routes already figured out. He uses assumptions and tests those assumptions gradually.

> *Experience is the best teacher here. In some cases it is even good to explore a bit and then fail, then you might end up with the very good end result finally. Some room for maneuvering needs to be there. Of course it helps if you have some back-up plans - if this goes wrong the whole game is still not over. [C2P2]*

Keith proceeds step-by-step, not taking too much of a leap at one time which also gives him confidence about being on the right track. Each step produces some tangible, understandable results. He tends to go towards simple solutions. Keith is able to quickly sketch out his initial ideas based on the customer need or on internal discussions and feedback. Experience with failure keeps Keith on track, that experience prevents catastrophic failures. He is "on his toes" all the time.

Keith and Mike (and Sam) are alike in a way they use and value experience and knowledge. Keith's imaginative nature guides him in a more creative direction than Mike. Keith realizes the danger in being too creative. That is why he uses back-up plans and safeguards to cover his back.

4.4.3 Negotiator

George is open and he always has vivid discussions with the team – he is a negotiator. He relies on good relationships within the team. Two conversational type negotiators were identified in the interviewee group.

The team where George works has worked together for a long time. Even though George is open in nature, it takes some time before George trusts a newcomer. During discussions, George raises past experiences, both successful and unsuccessful, in order to introduce a broader perspective.

George has an analytical approach to decision making when he is analyzing the data and proposes the decision to the team. The analytical stance that he has favors in having an official market, technology and competition analyses. George emphasizes the importance of direct feedback which can be obtained from prototyping the solutions with the customer.

> *The functionality of the product must be verified already at the very beginning of the development process with the customer. [C4P5]*

The conversational nature that George has is more controlled than with an imaginative person such as Keith. George does not let "thoughts fly" as Keith does in brainstorming sessions. This might be somewhat limiting to innovation but it brings more structure to the process itself.

Does George use intuition in decision making? Maybe, but that is not seen in the data of this study directly. Sometimes people camouflage the use of intuition in the form of well-articulated logical reasoning- either purposely or not – since having a rational explanation for the decision helps in justifying that decision to others. Rationality is appreciated in group decision making and when documenting the decisions.

George does not limit the intuition of the other people in the group, but he remains on the rational side of the decision making. This division of roles or responsibilities into intuitive and rational can be positive to the whole team since George is the person who ensures that the targets are

met, the process is documented and that heads are not too high in the clouds. Complementary knowledge of the team members is highlighted in the same way as in Keith's group.

> *We had these kinds of conversations pretty often. Sometimes those were very tempered but with the good friends you can say things directly without too much conflict others being offended. [C2P4]*

The importance of good and confidential customer relations is important for George. As in internal groups, he relies on having long term relations and personal relationships with the key stakeholders. "Lobbying" the stakeholders is one of the methods that George uses.

> *There were those contacts…we had a good name and we were appreciated within customers. [C4P5]*

Having confidential relationships with the customer gives you the ability to involve innovative solutions in the discussion. Those are not directly rejected because the earlier projects have built the trust between the parties. George appears to be a rational person. He is a technically oriented person. The only intuitive parts of his decision making are in limiting how he involves radical new ideas in the discussion – without thoroughly analyzing them.

4.4.4 Tester

James makes fast decisions and checks the results immediately by using a test – he is a tester. James proceeds cautiously in one way, but at the same time he is very fast. He takes a stepwise approach, making fast decisions with the ability to test the intuition or innovation immediately. Three testers were identified in the interviewee group.

James has a clear vision of the future and he has clearly outlined his path. He has a clear process which he follows and he regularly compares results against the targets and his vision. The importance of commonly shared and understood values and vision is high. James and everybody

working with him understand this and apply it to every decision making event. The process that James follows is simple and clear with defined key criteria of how to test the decisions and results in practice.

> *We have a vision and strategy and the targets what we want to achieve… then you have a process where you screen the ideas – harvest them forward… we test them continuously to find out how they fulfill our targets. [C1P1]*

Is James using intuition in the decision making process? The process and how it is followed is a very analytical approach to decision making. There is a vision which is commonly shared, the plans are derived from the vision and the plans are followed step-by-step with clear decision making points. However the ideas come from feeling. James relies on his gut feelings and puts that to the test. He dares to proceed since he has the immediate possibility of testing the decisions and come back to them if it is needed.

> *It is based on your gut feeling…then we have those test cases and we follow if it goes well in those cases. [C1P2]*

James never strays down the wrong path for too long. That is the reason why James is so quick in his decision making. He knows that he will get immediate feedback and can steer the process in the right direction based on that feedback. James uses gut feelings with a direct feedback loop. If he was not a fast decision maker, the whole process would slow down and eventually collapse.

> *We had different streams which operated almost all the time in decision making situations… in every meeting we were able to make decisions…the basis for the decisions where found as deep as your own values… [C1P1]*

Typically the interaction with the customer was tight in testing the decisions. James has always been close to customers and he needs to keep that contact alive and sharp in order to get real time feedback into the process. He is also active in forming marketing messages based on inno-

vations. The lead user, beta testing or piloting groups are the typical tool James uses to operate as well as cross-organizational task forces.

> *The best way to get insight of what is needed is to keep real close to the user – all the time. [C1P3]*

The "pipeline" between the customer and development has to be kept to a minimum length so that the information remains as "raw" as possible. This builds the responsiveness and flexibility to the whole process. It also encourages all of the participants when they see that their response is taken immediately into account and it has the effect on the results.

4.4.5 Discoverer

Chris likes to discover new things and he is really enthusiastic towards innovation. Chris is discoverer. There were four interviewees in the group who can be categorized as discoverers.

Chris seeks new paths, new breakthroughs and sometimes selects the wrong way – as all discoverers do. Still he accepts that and tries anew with a different approach or path. Chris is very enthusiastic and personally dedicated to innovation. He has the desire to innovate new things. Chris seeks solutions to problems and he is proud of what he has been able to discover.

> *It was crystal clear already in the beginning that this [product] has to be done. We innovated and developed that mostly by ourselves… in the background it was still however the customer's problem or need. [C3P1]*

Discoverers are deeply involved in problem solving and have a deep understanding of the substance either in a technical context or in a business context. Chris is also active in protecting the intellectual property rights of his inventions - patenting the solutions. Discoverers actively seek room for innovation and search for innovativeness in their customers or their own organization's operations. Chris is usually part of the unofficial team who actively discusses and processes the ideas.

> *...it is the people in the field who are good at pointing out these flaws and problems, they are always the best innovators. They are the ones who really can dig out the new innovative things. [C2P1]*

His decision making has an analytic approach with clear ways of working and clear processes. Mathematical models are used to evaluate different solutions. Sometimes Chris is a stereotypic engineer with problem solving models and finely graded scoring tables. Decision making is labeled depending on the problem solving approach used to solve commercial problems from customers. How does Chris use intuition in his work?

Even though Chris is keen on using clear models to evaluate solutions, decision by feeling is the main reason for agreeing to decisions. The importance of experience and knowledge is the basis for which Chris builds on his intuition. A discoverer goes forward step-by-step like a tester but he is not so dependent on being able to test the solution or decision immediately. Discoverers tolerate uncertainty longer than testers.

4.4.6 Believer

John knows how to proceed, he is very self-confident in his actions. John believes he has the right solution – he is a believer. Believers have a high self-confidence and a trust that they know what they are doing. Two believers were identified in the interviewee group.

Even though John has high degree of self-confidence he works well with the team, he is not going on alone. However, there must be a high degree of trust between the team members. John does not want to waste any effort on solving trust related conflicts inside the team, everyone must be committed to working towards a common goal.

> *It needs high commitment from the whole team...Well, it's a trust issue, and if we have different ways to handle the issues inside the team it takes too much effort... [C2P4]*

John believes he has correctly assessed the needs and values of the market. He makes assumptions and acts based upon them. Assumptions are highly based on John's opinions or feelings about the case – his intuition. Those feelings are even stronger and more grounded in John's way of acting as with James's, who is a tester.

> *...we believe that end users value it much...we have an assumption, from which we build up the case... [C1P1]*

The strong beliefs are based on strong self-confidence and knowledge. Sometimes John appears to be arrogant in his actions. A believer has the biggest risk of failure, since he blindly trusts his own opinions and intuitions as a self-evident, without questioning them.

4.4.7 Seer

Tom is able to quickly formulate the trends that what he sees happening - he is a seer. Three seers were found in the interview group.

Tom follows the technological debate and can see the best next steps in order to take advantage of those technological advancements. Tom is able to look several steps forward and see commercialization facts about what needs to be taken into account at the very beginning.

> *We saw that [technology] will advance... we have seen that we have some strengths... [C4P1]*

Tom does not make much noise, but he does very well with both technology and business. However, he is not like Mike – a drifter – because Tom works actively in the process. Tom is sometimes seen as "besserwisser" with his opinions. In that sense he has the same arrogant qualities as John. Tom is able to argue for his opinions so that they gain acceptance.

Intuition appears in Tom's role in the way he "sees" things fitting together.

> *We saw that such technology fits in to this picture…we saw that it fits to our strategy…then we finally saw that it is possible and viable to implement [C3P2].*

Tom lobbies internal and external key stakeholders to get his opinions accepted and implemented. With a forward looking ability Tom is able to plan and to take the necessary actions in the right order with the right people. His political approach to the process is not that visible as with George's role. Tom is a senior doer and knows the backgrounds, individuals and previous decisions.

Tom is the most senior technical person on the team and he relies on his competence when it comes to arguing the pros and cons of the solutions. He sees self-evident possibilities with which to combine technological possibilities with commercial needs.

4.4.8 Summary after the third encounter with the data: Decision makers' approaches in using intuition

The interview data revealed seven different role types and approaches that decision makers have in using intuition. These descriptions are adding the knowledge in intuitive decision making research concerning individual decision maker. These types share some common characteristics but it is possible to differentiate them from each other. Some of the roles are closer to each other than others as was described in previous chapters. Figure 4.3 visualizes the connections between role descriptions. The visualization is based on the commonalities between the roles. The commonalities are derived from the role descriptions and the previously presented code-person matrix table (see Table 4.1). There is a connection between the role descriptions if they share some of the codes.

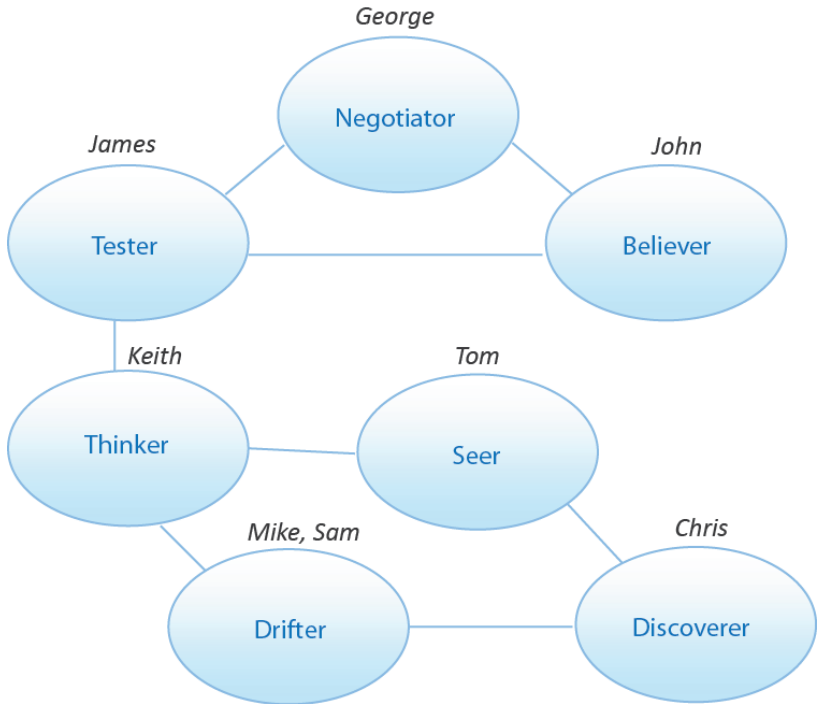

Figure 4.3 Illustration of the role descriptions and their connections (based on commonalities).

A drifter has clear non-active component which is not visible in any other roles. All of the other roles are more active actors in the decision making process. A drifter shares some commonalities with discoverers because they both have a lot of experience in their background. They can also tolerate uncertainty better than other roles. Drifter and thinker values high the importance of experience and knowledge.

A tester has a strong tendency to rely on possibility, to test the results immediately. Testers also share the qualities with believers who believe in their own feelings and have high self-confidence. They both proceed and then check. They act decisively based on gut feelings. A tester has also shared commonalities with thinkers since they both prepare back up plans. Tester and negotiator are close to each other since they have a common characteristic in working close with the customer and prototyping the solutions with the customers.

Believers and negotiators complement each other and thus make a good pair. Negotiators are more management oriented whereas believers have a strong engineering focus. Believers and testers share a common vision, a tendency to guide their actions.

Discoverers are at the extreme in their enthusiastic exploration of new possibilities. No other role type has such a drive towards innovation. They are explorers by nature. A discoverer also follows his own path and does not want too many counterparts to slow down the innovation advancement. A discoverer and seer are located next to each other because of their commonalities and enthusiastic innovation focus.

Thinkers and seers are close to each other. A seer is the most knowledgeable and technically oriented in the whole group and he sees new technological possibilities whereas a thinker is able to see possibilities because of his other non-technical qualities. Seers and thinkers use intuition mainly in the sense-making process phase. Thinkers and testers share the same tendency towards back-up plans. Thinkers proceed more cautiously than testers but they both rely on the existence of a secondary route if the first one fails.

A negotiator is an easy going person who easily moves the group forward along the decision process. He takes the time to develop paths forward together with the team. Negotiators do not like to take an impulsive role on the team – like discoverers. Instead seers, thinkers and testers are the better candidates to negotiators team.

The summary of the role descriptions is shown in role-description matrix in Table 4.2. Descriptions are linked with the description for the use of intuition in decision making, the type of intuition (affective, experience based (heuristic), holistic) and domain in which certain types are typically working (engineering, management) also the way of working is described based on the interview data.

Table 4.2: Role descriptions matrix

	Use of intuition	Intuition type	Domain	Work habit	Note
Drifter, Mike and Sam	Usually does not recognize the use of intuition. Supportive use	Holistic. Experience based	Engineering	More on his own. Solid company man. Substance expertise	Active and passive drifters
Thinker, Keith	Uses intuition in sensemaking process. Seeks complementary knowledge.	Heuristic. Experience based	Engineering	Stepwise forward. Second route prepared. Team worker	
Negotiator, George	Not visible	Holistic	Management	Trust seeking. Analytic approach. Prototyper. Active teamworker	
Tester, James	Uses intuition fast in as early as possible during decision making	Heuristic	Management	Common visio. Process oriented. Pushes forward	
Discoverer, Chris	First intuition then analysis	Holistic	Management	Exploring forward. High innovation push. Tolerates uncertainty	
Believer, John	Assumptions are intuition based	Holistic	Engineering	Self confident. Still team player. Strong experience. Risk of mistakes	
Seer, Tom	Intuition guides the way forward - seeing.	Holistic	Engineering	Technological. Seniority	

4.5 Survey questionnaire results

As described in the methods section the Rational Experiential Inventory (REI) self-test was used to study intuitiveness and the use of intuition of decision makers. The study seeks to understand the actual use of intuition in experienced decision makers. The study also seeks to understand the differences between experienced and inexperienced decision makers by using a control group consisting of inexperienced decision makers.

The sample included 18 interviewed experienced decision makers and 86 other decision makers. The demographics are presented in the methods section. Participants completed the long version of REI (Pacini & Epstein, 1999). The long version of REI consists of 40 likert-scale items (1=completely false – 5=completely true), 10 for each subscale (experiential engagement, rational engagement, rational ability, experiential ability). Engagement describes preference for that mode of thinking and ability describes belief in one's own ability to successfully use that mode.

4.5.1 Variable structure

To validate the REI measurement construct structure, a factor analysis was done for measurement constructs. The REI questionnaire items were entered into factor analysis with the Varimax rotation using SPSS Statistics software tool (SPSS). An orthogonally rotated solution was used. Based on the examination of the interpretability factors, four factors were extracted as in original REI.

Based on the analysis, a REI factor model was cleaned by omitting 13 questions/measures because of their unsatisfactory and contradictory factor loadings, so the final factor model included 27 items. The final factor model with the factor loadings is presented in Table 4.3 (The survey questionnaire with full questions is available in Appendix B). This factor model is acceptable but it is to be noted that there was a high number of cross-factor loadings.

Table 4.3: Final factor model used in the survey data analysis

	Component			
	Exp.eng.	Rat.eng	Rat.ab.	Exp.ab.
I often go by my instincts when deciding on a course of action	**0,87**			
Using my gut feelings usually works well for me in figuring out p	**0,74**	-0,22	-0,23	
I trust my initial feelings about people	**0,63**			
I believe in trusting my hunches	**0,56**	-0,34		-0,24
I tend to use my heart as a guide for my actions	**0,55**	-0,35	-0,28	
Knowing the answer without having to understand the reasonin	**0,54**			0,31
I try to avoid situations that require thinking in depth about som	**0,52**	0,24		0,48
I like to rely on my intuitive impressions	**0,50**	-0,43		0,24
Intuition can be a very useful way to solve problems		**-0,72**		0,27
If I were to rely on my gut feelings, I would often make mistake		**0,71**		
I would not want to depend on anyone who described himself o		**0,65**		
I suspect my hunches are inaccurate as often as they are accu		**0,64**		
I don´t like situations in which I have to rely on intuition		**0,64**		
I don´t think it is a good idea to rely on oneÂ´s intuition for impo		**0,58**		
I can usually feel when a person is right or wrong, even if I can´	0,22	**-0,40**	0,22	
I enjoy solving problems that require hard thinking			**0,77**	-0,21
I have a logical mind			**0,76**	
I usually have clear, explainable reasons for my decisions			**0,69**	
I am much better at figuring things out logically than most peop			**0,67**	-0,34
I enjoy intellectual challenges			**0,67**	-0,40
Using logic usually works well for me in figuring out problems ir	-0,20		**0,60**	
I don´t reason well under pressure				**0,70**
Reasoning things out carefully is not one of my strong points				**0,58**
I´m not that good at figuring out complicated problems			-0,23	**0,56**
I don´t have a very good sense of intuition		0,31		**0,52**
I have no problem thinking things through carefully	-0,21			**-0,37**
I am not a very analytical thinker	0,33		-0,23	**0,33**

The variable structure between the original REI and the resulting model of the factor analysis is significantly different. However, four extracted factors were characterized by the original REI (experiential engagement, rational engagement, rational ability, experiential ability) variables. The naming of variables is the same as in original REI. Experiential refers to the intuitive terminology in this study. Ability refers to a person's belief in their own ability to use the mode, and engagement refers to one's preference for the mode, Table 4.4.

Table 4.4: REI variable structure

REI variable name	Variable description
Experiential engagement	Persons preference to use experiential methods e.g. intuition in decision making
Rational engagement	Persons preference to use rational methods in decision making
Rational ability	Person's belief in their own ability to successfully use rational methods in decision making.
Experiential ability	Persons belief in their own ability to successfully use experiential methods in decision making

A four factor (cleaned) solution explained 48.44% of the total variance (19.65%, 14.62%, 8.54%, 5.63%). The scree plot is presented in Figure 4.4 . The explanatory power of the model would have been better if more factors (six factor model) could have been taken into account in the model, but since the original REI included 4 variables the same number of variables were used here.

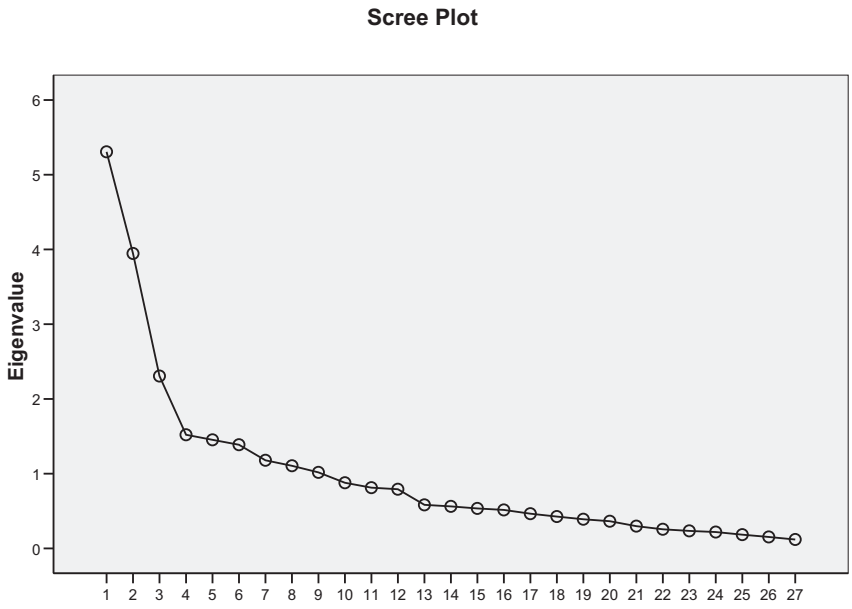

Figure 4.4: Scree plot of cleaned factor model.

Originally, the 10 items for experiential ability was reduced to six items. Cronbach's inter-item coefficient alpha for the experiential ability is 0.60. The rational ability items were also reduced to six. Cronbach's inter-item coefficient alpha for the rational ability was 0.81. Rational engagement constructs were reduced to seven items. Cronbach's inter-item coefficient alpha for the rational engagement is 0.76. The remaining eight items were used to operationalize experiential engagement. Cronbach's inter-item coefficient alpha for the experiential engagement is 0.81.

4.5.2 Descriptive statistics and correlations

Descriptive statistics and correlations of the used (cleaned) measurement constructs are presented in Table 4.5. Engagement and the ability to have strong positive correlations were expected. Negative correlation in experiential ability and experiential engagement could reflect intuitive abilities a person have that he is not – at least intentionally – using. The more abilities he has the more cautious he is in using those abilities.

Table 4.5: Descriptive statistics

	Mean	Std. Deviation	What is your accumulated working experience ?	How many years have you been in your current organisatio ?	What is your highest education ?	Target group: experienced or not	Experiential engagement	Rational engagement	Rational ability	Experiential ability
What is your accumulated working experience ?	3,51	1,25								
How many years have you been in your current org	1,69	0,97	0,32**							
What is your highest education ?	1,90	0,91	0,20	0,02						
Target group: experienced or not	0,21	0,41	0,41***	0,52***	0,19					
Experiential engagement	2,82	0,57	0,09	0,08	0,11	0,06				
Rational engagement	3,36	0,56	0,03	0,17	-0,14	0,06	0,40***			
Rational ability	4,04	0,52	-0,07	0,09	0,05	0,11	-0,20	-0,08		
Experiential ability	3,97	0,49	-0,04	0,04	-0,10	0,05	-0,25*	0,10	0,39***	

4.5.3 Results

The difference between intuitive and rational engagement and the abilities of experienced and inexperienced decision makers was compared in

this study. Mean values and standard deviations were calculated for the groups based on their REI test results. The results of the comparison between the experienced and inexperienced managers showed that there are no significant differences in the engagement or ability on either the rational side or experiential/intuitive side. This result is clearly adding the knowledge in intuitive decision making research, since results from the previous research has shown that experienced decision makers use intuition more than inexperienced decision makers.

A T-test was used to verify the statistical validity of the results. The results of this test are presented in Table 4.6. No statistically significant difference was found between the results from the experienced and the inexperienced decision makers. Also there was no significant difference in the distribution between the experienced and the inexperienced decision makers (x^2).

Table 4.6: Results, Chi-Square (x^2) and t-test

	Experienced, n=18		Other, n=68				
Target group: experienced or not	**mean**	**s.d.**	**mean**	**s.d.**	**x^2**	**t**	**p.**
What is your accumulated working experience ?	4,50	0,79	3,25	1,23	16,44		n.s.
How many years have you been in your current org.	2,67	1,46	1,43	0,58	29,65		n.s.
What is your highest education?	2,22	0,94	1,81	0,89	6,78		n.s.
Experiential engagement	2,89	0,69	2,81	0,54		-0,54	n.s.
Rational engagement	3,42	0,60	3,34	0,56		-0,51	n.s.
Rational ability	4,16	0,44	4,01	0,54		-1,05	n.s.
Experiential ability	4,02	0,35	3,95	0,52		-0,63	n.s.

The experienced decision makers analyzed in this study had high scores in both rational and experiential abilities and were close to the median in rational and experiential engagements. The control group, consisting of inexperienced decision makers had almost the same results. This challenges the previous research, which has found noticeable differences between the experienced and inexperienced decision makers (Dane & Pratt, 2007; Harper, 1988; Isenberg, 1984; Sadler-Smith & Shefy, 2004).

The matrix of role descriptions which was presented in chapter 4.4 is added to the REI scores and is presented in Table 4.7. The results did not provide any new insights into the use of intuition between different

roles. Intuition type (affective, heuristic, and holistic) or domain (engineering, management) did not show any noticeable difference in the REI results. This may also be because of the relatively weak reliability of the REI model and its ability to explain in detail the use of intuition.

Table 4.7: Role descriptions matrix

	Use of intuition	Intuition type	Domain	Work habit	Note	REI (Rat.-Exp.)
Drifter, Mike and Sam	Usually does not recognize the use of intuition. Supportive use of intuition.	Holistic. Experience based	Engineering	More on his own. Solid company man. Substance expertise.	Active and passive drifters	High-High
Thinker, Keith	Uses intuition in sensemaking process. Seeks complementary knowledge.	Heuristic. Experience based	Engineering	Proceeds stepwise forward. Second route prepared. Team worker.		High-High
Negotiator, George	Not visible.	Holistic	Management	Trust seeking. Analytic approach. Prototyper. Active teamworker		High-Med
Tester, James	Uses intuition fast as early as possible during decision making.	Heuristic	Management	Common vision. Process oriented. Pushes forward.		High-High(med)
Discoverer, Chris	First intuition then analysis.	Holistic	Management	Exploring. High innovation push. Tolerates uncertainty.		High-High
Believer, John	Assumptions are intuition based.	Holistic	Engineering	Self confident, still team player. Strong experience. Risk of mistakes.		High-Med
Seer, Tom	Intuition guides the way forward - seeing.	Holistic	Engineering	Technological seniority.		High-High(low)

4.6 Synthesis

Based on the interview analysis, decision making plays a significant role in innovation management. This was reported as one of the core categories after the first encounter with the interview data. Decision making core category was further analyzed and non-rational decision making elements came up as one of the key elements during the data analysis. These non-rational elements were grouped under a common term – intuition.

The second encounter with the data concentrated on studying and analyzing how intuition reveals itself in the decision making and innovation management front end. It resulted in a four faceted intuition frame description with core categories: *Symptoms, preceding and simultaneous*

enablers and safeguards. Intuition appears in different ways in decision making and the symptoms for of the use of intuition vary. There are prerequisite elements (enablers) which are needed for a fruitful environment for the use of intuition in decision making. Temporally close to intuition use are intuition enablers and safeguard components. Enablers ease the use of intuition and safeguard are there to verify that the decision was acceptable and that there are ways to reflect and learn from the decision making process. Preceding enablers and safeguards are organizational-level items which need to be in place to make the use of intuition possible – either to foster it or to secure it. Preceding enablers work further away from the use of intuition, but are needed to build grounds for the use of intuition.

The third encounter with the data revealed what approaches and individual roles decision makers have when using intuition. Seven different role descriptions and approaches in using intuition emerged from the data *(drifter, thinker, negotiator, tester, discoverer, believer and seer)*. These approaches that decision makers have to using intuition clearly differ between roles. There are different roles and identities amongst the persons using intuition. Roles have different qualities which can be described and evaluated. This provides the basis that there is a possibility for changing and developing the use of intuition in decision making. The role descriptions share some characteristics but it is possible to differentiate them from each other. Some roles work better together in a team than others as was described in chapter 4.4.

Figure 4.5 describes the relationships in the intuition framework and the role description components categorized by individual, environmental and organizational perspectives of innovation management. The categorization of those three perspectives used in this study is the theoretical lens used to organize the innovation literature (Balachandra & Friar, 1997; Reid & de Brentani, 2004; Van de Ven, 1986). In Figure 4.5 the theoretical framework of individual, environmental and organizational perspectives of innovation management (chapter 2) are linked to the developed four faceted intuition frame based on interview data analysis done in chapter 4.3 of this study, including the role descriptions developed in chapter 4.4. It is acknowledged that this linkage is not as straightforward as it now seems. The synthesis is to be taken within the

context of new product development front end and not to put it directly into another context.

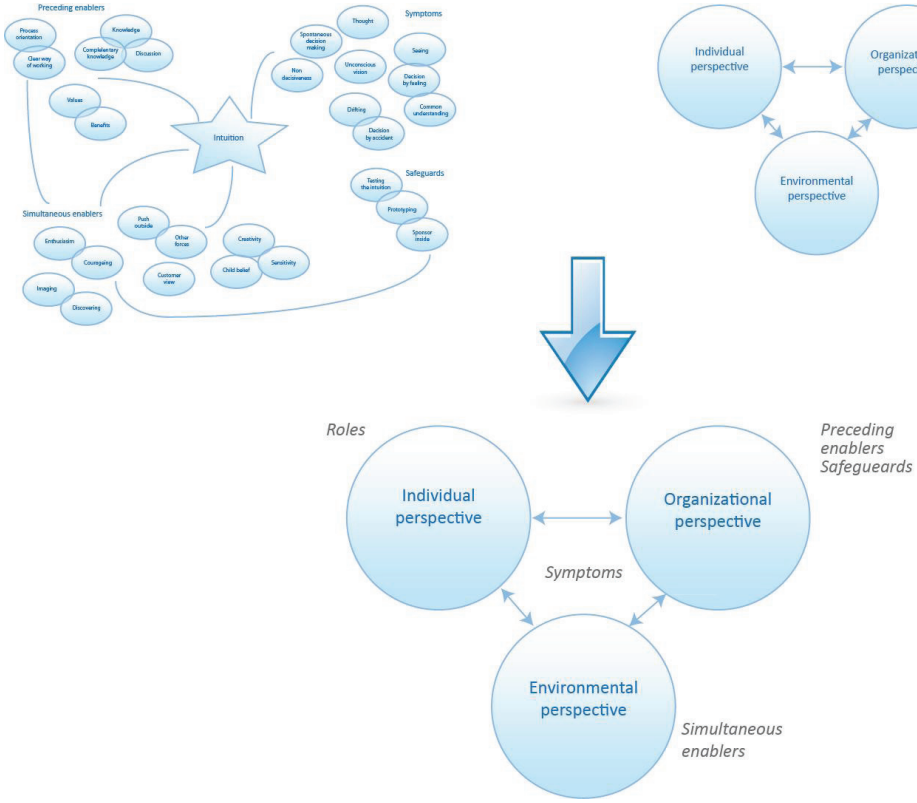

Figure 4.5: Synthesis and relations of intuition frame and three perspectives to innovation management

The survey conducted on experienced and inexperienced decision makers also showed that decision makers use intuition in their actions. Generally speaking no significant difference was found between experienced and inexperienced decision makers in the use of intuition, both use intuition equally. The mean in ability to use intuition is on high level and the mean in engagement is on average level as shown in Table 4.6. The result is interesting since it challenges the prevailing view that experienced decision makers differ from inexperienced decision makers in their use of intuition. This is elaborated more on discussion chapter of this dissertation.

If the use of intuition is looked at in more detail on experienced decision makers' role level, some differences were found between the different roles. Heuristic based intuition type role, tester, is making decisions more based on rational analysis than on intuition. Tester relies on having the possibility to test the results of the decision and he makes the decision fast, but he keeps the rational analysis as a foundation where to base the intuitive decision.

Also holistic based but engineering domain role, believer, base the decision making more on rational analysis than on intuition. Believer's fist assumptions come more from intuition but the final analysis is rational. The role descriptions were formulated to describe the different approaches what decision makers' have in using intuition and not to link those directly to the interviewed persons. That's why the results of the survey questionnaire cannot be interpreted straightforward vis-à-vis to the roles.

Cognitive frameworks and mental models are used to describe intuitive decision making. Cognitive frameworks are developed based on work, life experience and education. Both cognitively based intuition (experience, seeing the bigger picture, sense making) and affectively based intuition (gut feelings) are needed for effective innovation decision making. The combination of both, the holistic perspective combines the two original descriptions. This study defines the approaches that decision makers have in their use of intuition and linked them to the three intuition definitions (affective, experience based, holistic).

Holistic intuition was the most frequent type of intuition. This could be because all of the interviewed and surveyed respondents were relatively experienced. Even though the control group in the survey consisted of inexperienced decision makers, they were not newcomers to the business nor to engineering. The importance of experience and cumulated tacit knowledge is noticeable. Intuitive decision making is based on past experience and knowledge.

5 Discussion

"The really valuable thing is intuition"
Albert Einstein

The results of this dissertation are discussed in the following chapters in relation to the existing literature in order to present the contribution made by this this research. In order to further elaborate the research findings, the results of this dissertation are discussed more broadly than in the other literature that was presented in the literature review section. This is done in order to present possible new avenues for future research and to extend the scope of the findings to other relevant literature. The literature review section was purposely as compact as possible. I wanted to present other literature here also, which was brought up while writing of results and discussion sections.

This chapter is organized as follows. Firstly, research questions are used as a framework to analyze the results of this dissertation. Secondly, the theoretical contribution is made visible based on innovation and NPD front end literature as well as decision making and intuition literature. The contribution to intuition research instruments is also discussed. Thirdly, practical implications of this dissertation are highlighted. Fourthly, the study is evaluated using criteria for qualitative and quantitative (survey questionnaire) research. The final chapter of this dissertation proposes the avenues for future research.

5.1 Responses to research questions

The purpose of this research has been to explore the front end of innovation, to study how innovation projects gets decided upon, who makes the decisions and how those people make decisions. The aim of this research has been to gain a deeper understanding of decision makers' use of intuition and to offer new theoretical end empirical insights in the use of intuition in decision making at the front end of innovation. This aim was further divided into three research questions which are answered based on the empirical findings of this study and compared to the existing literature.

Question 1: How does intuition reveal itself in innovation front end decision making?

First encounter: Decision makers' experiences of innovation management

In the first encounter with the research data, the evidence from the interviews with experienced decision makers, revealed three categories affecting innovation management: decision making elements of innovation management, innovation enablers and compelling forces that push the innovation process forward. The decision making category was studied further in this dissertation. The two other categories also play a major role in innovation management and some discussion of this occurs in later parts of this chapter, but the detailed analysis for those categories is left to forthcoming studies to research further.

Decision making

The interviewees in this study all discussed the early phases of the innovation process where the selection and decisions concerning new innovation were in the focus. The findings of this study support previous research concerning the early phases (front end) and the importance of decision making at the front end of innovation (Adams et al., 2006; Calantone et al., 1999; Cormican & O´Sullivan, 2004; Khurana & Rosenthal, 1998; Krishnan & Ulrich, 2001). One of the shared codes between the decision making elements and innovation enablers was a "clear way of working", which is especially connected to the innovation process.

The importance of decision making in innovation management in general and NPD in particular was also remarkable in this study. These results complement the previous research in innovation management from the environmental side e.g. (Christensen & Raynor, 2003; Eisenhardt, 1989c; Leifer et al., 2000; Tushman & Anderson, 1987; Utterback, 1994), from the individual side e.g. (Chakrabarti, 1974; Gemunden et al., 2007; Rothwell & Gardiner, 1985; Schmidt et al., 2001; Thamhain & Wilemon, 1987; Tushman, 1977) and from the organizational side e.g. (Adams et al., 2006; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1998; Krishnan & Ulrich, 2001; Reid & de Brentani, 2004) where the importance of decision making has also been highlighted.

The interviewed persons in this study were all senior and experienced decision makers. Their roles in the companies are closely related to gate keeper, champion and promoter roles. This study has made visible the individual roles in innovation decision making with the role-specific characteristics and their appearance and behavior in decision making at the innovation front end. The results of this dissertation add new evidence to previous research, touching on champions and promoters (Chakrabarti, 1974; Gemunden et al., 2007), and boundary spanning and gatekeeper roles (Reid & de Brentani, 2004; Tushman, 1977; Tushman & Katz, 1980) by showing how decision making is present in their work. Individuals had different roles and positions in decision making incidents and that is seen from the presented role descriptions. The role of decision making at the innovation front end is reflected by the approach that each individual has to innovation front end decision making. The individual component is answered in more detail during the discussion of the second and third research question and later in this chapter.

The importance and difficulty of decision making is accentuated at the front end phase of innovation where the uncertainty is highest. The core category “decision making” was analyzed further in more detail during the first encounter and especially during the second encounter with the full interview data. The “decision by feeling” category and the sub codes like “spontaneous decision making” were noted in the majority of the front end decision making descriptions. That guided the analysis to look what is happening in those situations.

When looking more closely at the decision making at the innovation front end, as described by the interviewees, one of the decision making elements found was intuition. The use of intuition is highlighted in the discussions and answers of the experienced decision makers in the results of the interview analysis and questionnaire survey results. The intuition was not purposely highlighted in the interviews, but the use of intuition can be found in the way experienced decision makers describe their behavior and decision making practices. These results challenge the prevailing view about the superiority of rational decision making methods in innovation management (Cooper, 1990; Khurana & Rosenthal, 1997; Krishnan & Ulrich, 2001) and in new product development (Büyüközkan & Feyzioglu, 2004; Calantone et al., 1999; Montoya-Weiss & Calantone, 1994; Souder & Mandakovic, 1986), where the development of decision making models has been to concentrate on building new rational and analytical methods. However, the ever-increasing amount of data and complexities and uncertainty in fast paced decision making situations will make this approach even more challenging in the future. The results of this study provides new evidence and knowledge to that discussion and develops the picture of the use of intuition in decision making in innovation management as a one path to going forward in developing innovation management practices.

This study challenges previous conceptions and emphasizes approaches other than rational decision making methods at the innovation front end. The findings support intuitive decision making literature findings concerning strategic decision making (Khatri & Ng, 2000; Miller & Ireland, 2005; Sinclair & Ashkanasy, 2005; Sinclair et al., 2009), uncertainty in decision making (Kahneman, 2003a; Tversky & Kahneman, 1974) and managerial decision making (Agor, 1986; Dane & Pratt, 2007; Isenberg, 1984; Sadler-Smith & Shefy, 2004; Shapiro & Spence, 1997; Simon, 1987). Based on the results of this study, intuition plays a large role in strategic decision making (decision making concerning innovation management can be regarded as strategic). The existence of intuition in decision making was discovered in the experienced decision makers' expressions when they discussed their innovation management practices. The findings of this study complement the results of previous studies in highlighting intuition as viable tool in NPD front end decision making (Dayan & Di Benedetto, 2011; Hart et al., 2003; Stevens & Burley, 2003; Tzokas et al., 2004; Van Riel et al., 2011; Yahaya &

Abu-Bakar, 2007). This was uncovered in more detail during the following encounters with the research data.

Innovation enablers

The other two categories that emerged during the first encounter with the data were innovation enablers and compelling forces. Innovation enablers are organization and environment-related aspects that enable innovation to surface and continue in an organization. Innovation enablers was a natural category since the interviews were about innovation management. The discussions easily went along the paths describing what made innovations possible in companies. All of the companies are building offerings for the marketplace, so it is natural that "customer orientation" and "productization with the customer" were raised as the key codes in the data analysis.

The organizations in this study varied from mid-size to large global organizations. However, the individuals interviewed from large global organizations were discussing innovations within their team or unit. One common theme that was raised by the majority of the interviews was related to innovating with the customer – regardless of whether the customer was another company or a general consumer. This does not make any difference between different organizational structures or the size of the organization and challenges previous research where the size of the company size had been found to have an effect on innovation success (Rothwell, 1983, 1993). Whatever the size or the structure the close linkages to the customers and users are needed in order to make the right decisions. These findings support previous research that organizational set-up - customer oriented organizations – has a positive effect on innovation success (Khurana & Rosenthal, 1998). Organizations of all sizes and structures should be organized so that customer orientation is achieved.

The final decision at the front end is often dependent on an individual decision maker. Findings from this study revealed the differences in the innovativeness of the decision makers and differences in how decision makers use intuition in decision making situations. The role of individuals in innovation management has been researched from the individual competencies point of view and also from a team composition point of view. Previous research on the individual side has presented different role descriptions (champions, gate keepers, boundary spanners, promoters) that have differ-

ent qualities in innovation projects (Chakrabarti, 1974; Gemunden et al., 2007; Tushman, 1977; Tushman & Katz, 1980; Zirger & Maidique, 1990). The results of this study complement previous research by explaining how those individuals use intuition at the front end of innovation.

The interviewed persons highlight "complementary knowledge" from a team composition point of view. The team where knowledge and competencies exist in the different areas fostered innovativeness in the interviewed companies. The importance of communication networks has been highlighted in the previous research (Allen, 1970). The same aspects of team composition have been raised by Thamhain and Wilemon (Thamhain & Wilemon, 1987). They found that team performance is related to leadership, job content, personal needs and general work environment. One of the driving elements in a work environment was team communication. Previous research has found that the best performing teams had a diversity of individuals (Day & Schoemaker, 2004; Schmidt et al., 2001; Thamhain & Wilemon, 1987). Even though the results of this study explain the use of intuition at an individual level, innovation in organizations is typically a team-level activity and the importance of communication is evident. Recent studies concerning team intuition found that teams use intuition in turbulent environments (Dayan & Di Benedetto, 2011). This supports the results of this study, since the studied NPD environments are usually turbulent.

Compelling forces

The third innovation management category, compelling forces, is what is needed to push innovation forward in the organization. People and organizations need compelling forces to make the necessary decisions and actions. Compelling forces are related to environmental issues in innovation management. One environmental characterization is a high velocity environment.

The evidence from the interviews support previous research findings on the importance of decision making in innovation management and changing decision making approaches especially in high velocity environments – the environments researched in this study (Eisenhardt, 1989c, 1999). Compelling forces in high velocity environments, especially the "competing in the marketplace" and "changing business environment" codes, highlighted the existence of compelling forces and the importance of decision making as

one component for successful innovation management. These decision making styles are faster and the room for rational and analytical analysis is limited because of compelling forces. Innovation management in the software or telecom industry can be regarded as a high velocity environment and the decision making approach has the same characteristics. The life cycle aspects already raised by Abernathy and Utterback (Abernathy & Utterback, 1978) present different decision making approaches based on the industry life cycle phase. High growth and innovative industries have different decision making approaches than do low growth in low innovation industries.

Second encounter: Facets on using intuition at the front end of innovation

The second encounter with the research data revealed the use of intuition in more detail and resulted in describing the "four faceted intuition frame". That is one of the significant findings of this study. These facets provide a means to study the use of intuition in more concrete way. The appearance and use of intuition can be characterized based on the symptoms, preceding enablers, simultaneous enablers and safeguards (see Figure 4.2).

Symptoms indicate that intuition is present in decision making despite that the lack of "visible" signals. This is how to discover the use of intuition, since the use of intuition is often unconscious and not directly noticeable. The interviewed persons did not directly speak about the use of intuition. Instead they used expressions like: decision by feeling, spontaneous decision making, unconscious vision, individual thought process, indecisiveness and decision by accident. There are thus no reliable instruments available to uncover it otherwise. That was the challenge of quantitative instruments in studying intuition and one of the reasons the main instruments and methods of this study were qualitative.

Preceding enablers are subjects that need to be present so that the intuition is used in the decision making process. When decision making occurs in close proximity, simultaneous enablers work in favor of using intuition in decision making.

When the decision is already complete, safeguards are helping the decision maker to verify the "correctness" of the intuitive decisions which were done. The existence of safeguards can be seen as one kind of intuition enabler for the decision maker. Safeguards can also be seen as one means of increasing the flexibility in the innovation process (Buganza & Verganti, 2006). Safeguards are also related to reflective learning research (Ortt & Smits, 2006; Perminova et al., 2008), by proposing one element which enables reflective learning in innovation management.

These findings support the intuitive decision making literature e.g. (Dane & Pratt, 2007; Hodgkinson et al., 2008; Miller & Ireland, 2005; Sinclair & Ashkanasy, 2005; Sinclair et al., 2009) by providing new evidence and more detailed descriptions in the form of "enablers" of intuition in decision making and adds empirical evidence from the innovation front end. The discovery of symptoms also adds on the research concerning how practitioners experience intuition in their decision making (Raami et al., 2010). The use of intuition in decision making must be seen as a combination of symptoms, enablers and safeguards as shown in the Figure 4.2. In that way the full picture of the use of intuition in decision making is better understood.

The following chapters continues answering research question 1 and opens up the research findings of this study to new literature that was not evaluated in the literature review chapter. This is done in order to openly evaluate the findings and give the possibility of opening new research avenues based on the research findings.

When the results of the first and second encounter with the research data are further elaborated, the findings of this study can also be related to complex evolving systems (CES) (Mitleton-Kelly, 2003) or complex adapting systems (CAS) (Brown & Eisenhardt, 1997; Buijs, 2003; Chiva-Gomez, 2004; McCarthy et al., 2006). These research streams complement the study of innovation management and decision making contexts. Complex adapting systems are in constant change and do not operate in predefined ways where fixed processes and purely rational decision making approaches can be used. The role of intuition in decision making in complex adapting systems is notable since intuitive decision making is adaptable and fast and is able to cope with the constant change that all CAS/CES environments

have. McCarthy et al. (McCarthy et al., 2006) have viewed the NPD as a complex adapting system and proposed changing and adaptable decision making rules to cope with the situation. The use of intuition in decision making is one solution for that need.

The use of intuition in decision making in innovation management can also be explained as decision making in complex environments as described by Aaltonen (Aaltonen, 2007). Multi ontology decision making presentation can be complemented by adding intuitive decision making components in relation to complex ontology. If intuition and the use of intuition is seen to be the component in complex ontology, it is different than heuristics, since heuristics are more related to ordered ontology. The existence of heuristics, especially accessibility and availability, must not be underrated (Kahneman, 2003b). Heuristics are existent but the proportion of heuristics in decision making remains unclear. Intuition can still play a major role in complex environments and decision making situations.

The description of intuitive decision making in relation with multi-ontology sense making complements the multi-ontology sense making conception and connects the use of intuition in decision making in complex environments. Complex environments are environments where the most actively developing innovative industries exist and the tools needed to survive in these environments – like the use of intuition in decision making – are helping in surviving in those environments.

Question 2: What approaches do decision makers have when using intuition at the innovation front end?

Third encounter: Alternative approaches to decision makers' use of intuition

Answers to the previous research question discussed innovation management, decision making in the innovation front end and the use of intuition in decision making. Those answers guided the research towards more detailed questions concerning individual decision makers. The following chapters answer these questions in more detail.

The use of intuition is different based on the role that the decision maker has in the innovation front end. Decision makers have different approaches to the use of intuition in innovation decision making. Seven role characteristics describing the approach to the use of intuition were found from the interview data: Drifter, thinker, negotiator, tester, discoverer, believer and seer. Individuals in all of these roles use some proportion of intuition and rationality in how they make decisions but their approach to the use of intuition differs based on the role. These role descriptions can be regarded as a new knowledge especially in intuition literature and research. Figure 4.3 illustrates the relationships between the role descriptions based on commonalities (common codes) that they share.

Drifter, discoverer and thinker are roles in which use of intuition is based on long time experience or technological knowledge. The most senior technological person using intuition is seer. They appear differently in their organization's decision making situations, but the basis for their intuitive ability is their professional and decision making experience.

Negotiator is the role that uses intuition the least. He has a holistic approach to decision making and decisions are mainly based on an analytical approach. A negotiator has many of the same qualities as the believer. A believer is more engineering focused whereas negotiator is management-focused person. They both have a common vision to guide their actions even though intuition is not visible in their actions.

Testers are similar to believers and negotiators in their guidance by vision. However, testers are more in favor of experience based - heuristic - intuition whereas believers and negotiators have a more holistic approach.

Why are the role descriptions different? Since intuition and its use has developed based on experience and holistic view on issues, so has the context of the experience, educational background, and personal interest areas affected on the characteristics of how the individual uses intuition. It is a character trait and very person dependent. However, it is possible to form a set of role descriptions with some commonalities, as has been done in other role descriptions before (Belbin, 1993; Briggs & Myers, 1962; Gemunden et al., 2007; Mintzberg, 1973; Tushman, 1977; Tushman & Katz, 1980).

As the literature review reveals, empirical evidence and the use of intuition – the approach the decision maker has – is mixed. The role descriptions described in this study – a significant finding - depict a set of roles and their approach to the use of intuition from experienced decision makers' viewpoints working in the NPD context. There are more roles or different descriptions if inexperienced decision makers are added. A different context would have also produced a different set of characteristics and roles as the decision making style and the use of intuition is context dependent (Crittenden & Woodside, 2006; Eisenhardt, 1989c; Papadakis et al., 1998; Schoemaker, 1993).

The role descriptions presented in this study can be further elaborated with classical team role and managerial role descriptions by Belbin (Belbin, 1981, 1993) or Myers and Briggs (Briggs & Myers, 1962). The use of intuition is clearly more related to Belbin's intellectual monitor-evaluator (ME) team roles or Myers Briggs Intuition-Thinking (NT) roles. The monitor-evaluator analyses the problems and the level of intuition in this analysis could be elaborated. How are these intuitive roles related in detail to Belbin's team roles or MBTI roles is left for further studies to evaluate.

The decision makers' use of intuition and the role descriptions can also be evaluated together with other decision maker managerial role descriptions from previous research (Mintzberg, 1973). The decisional roles presented by Mintzberg (1973) were: entrepreneur, resource allocator, disturbance handler and negotiator. All of these roles could have an intuitive component in their decision making approach. Especially when combined with his later research concerning unstructured decision processes (Mintzberg et al., 1976), the results of this study could have revealed more insight into the connection between unstructured decision processes and decision makers' role descriptions. A combination of these role descriptions would be a fruitful addition to manager role description research.

Isenberg's (1984) description of senior managers' five different ways of using intuition (sensing the problems existence, rapid reactions, building integrated pictures, check for rational analysis, by-pass analysis) has some similarities to the role descriptions found in this study. The findings of this study are based on an NPD context and support previous findings of the

differences between different decision makers' approach to the use of intuition.

This study and the roles presented here have commonalities with all of the roles described in previous research concerning champions, promoters, boundary-spanners and gate-keepers (Chakrabarti, 1974; Gemunden et al., 2007; Reid & de Brentani, 2004; Tushman, 1977). These descriptions are derived from innovation the management context as are the roles from this study. The roles and the new approaches described here bring more understanding on decision makers' use of intuition and how that may reflect on managerial activities. All of the previously mentioned roles have to be engaged in decision making and the use of intuition in their decision making would be interesting topic for further research. Since managerial decision making is not always rational but based on intuition, the group decision making within decision makers using intuition differently would also be a topic for coming research. The approaches found in this study could act as a research framework for coming studies.

The role descriptions of this study were made based on studying the innovation front end. Based on the descriptions that the interviewees gave of their activities in innovation decision making, it can be said that the activity of the roles is different depending on the process phase. Seers and discoverers are more active at the very beginning of the innovation process because they have a strong innovative and forward looking stance in their actions. A tester is more active after decisions have been made and negotiators, thinkers and drifters are more active throughout the process.

The different role descriptions in previous research all state the different behavior of roles in different phases of the process, at different levels or positions in the organization or in different contexts. The findings in this study portray an additional description of roles that are active at the innovation front end, having experience in decision making in an NPD related context. The results provide new insight to the approach to the use of intuition, which has not been achieved using quantitative research instruments (Van Riel et al., 2011). These results provide more understanding on managers' use of intuition and how that can be reflected on decision making and managerial activities.

Question 3: How do experienced decision makers differ from inexperienced decision makers in their use of intuition?

The use of intuition did not differ significantly between experienced and inexperienced decision makers. Both have a high ability in intuitive decision making and they also use intuition in innovation decision making. Both groups have a high level in ability and average level in engagement for rational decision making. This can be considered as a new knowledge in intuitive decision making literature and research.

Uncovering the similarities between experienced and inexperienced decision makers is interesting. Previous research has shown that decision making style and practices changes and develops when you are more experienced or you have more knowledge e.g. (Raami et al., 2010; Stevens & Burley, 2003; Wally & Baum, 1994; Yahaya & Abu-Bakar, 2007). Similar findings from the research connected to leadership style and change development has shown that behavior and leadership style changes when you switch from a junior position to a senior position e.g. in champion role (Howell & Higgins, 1990). This study did not confirm these previous empirical findings. There are several reasons why the findings of this study are different than in previous research.

It is possible that the engineering context itself had already "selected" the similar types of persons in decision making positions. Previous research has shown that the context has an effect on decision making (e.g. (Crittenden & Woodside, 2006; Eisenhardt & Martin, 2000; Papadakis et al., 1998; Schoemaker, 1993). Despite one's experience, individuals also tend to use similar practices and methods in an engineering context. This is especially related to personal ability to use intuitive or rational methods.

Innovation decision making, especially at the front end of innovation is uncertain by nature and decision making practices can be quite similar because of the context of the decision. It is to be noted that not all of the inexperienced decision makers in this study's control group were directly connected to innovation decision making. But certainly, in the context of engineering companies, fast decision making situation in general are directing the decision making practices. Context and fast decisions are related to in-

tuitive/rational engagement. The role of the individual and the use of intuition can be stronger especially in radical/discontinuous innovations. This supports the findings of Reid and de Brentani (Reid & de Brentani, 2004, p. 182).

One reason for similarities in decision making style comes from the personality of the decision makers. It is possible that the personality types of these two companies are closer to each other, also because of the aforementioned engineering context. Is it the case that the engineering context as a growth path to managerial positions is relatively short compared to other industries? This could be the case, since the personalities and decision making practices of experienced and inexperienced managers are so similar.

The answer to this third research questions was achieved using the available quantitative research instrument. However, the construct validity of the Rational Experiential Inventory (REI) instrument left some problems to be solved. This criticism has also been raised in previous research (Hodgkinson et al., 2006; Pretz & Totz, 2007; Sinclair et al., 2009). The validity of REI as a research instrument needs to be evaluated in further studies. The acceptable factor model used in this study differed from the original REI factor model significantly and certainly needs further evaluation and development. The reliability of the model used in this study was not high. However, REI is the model used in many studies and the results received in this study add to the knowledge gained in previous studies that used the same model.

In this study, the original English REI question set was used. This may have had an effect on the results because almost all of the respondents were native Finnish speakers. It is always a matter of how you understand and interpret the questions, especially if the questions are not in your native language. However, all of the survey questionnaire respondents and interviewed persons have used English as their working language for several years, so language barriers should not largely affect their understanding of the questionnaire.

5.2 Theoretical contribution

The main contribution of this research is to intuitive decision making research. The research also contributes to the innovation front end and to NPD research. Contributions and new research avenues for the other research (e.g. sense making) are also briefly discussed in later chapters. This dissertation contributes also to the intuitive decision making research instrument body of knowledge by proposing a fruitful means of studying the use of intuition in decision making and challenging the validity and reliability of some of the prevailing survey based research instruments.

5.2.1 Contribution to intuitive decision making research

This study contributes to the intuitive decision making discussion by increasing our understanding of the innovation front end (Dane & Pratt, 2007; Hodgkinson et al., 2008; Matzler et al., 2007; Miller & Ireland, 2005; Sinclair et al., 2009) since the innovation front end has not been the context of previous intuitive decision making studies.

The results of this dissertation contribute to intuitive decision making research along several avenues. Firstly it brings new evidence and examples to the measurement of the use of intuition (Burke & Miller, 1999; Hodgkinson et al., 2008; Kahneman & Klein, 2009). Secondly, since decision making at the front end is judged to be strategic and contain a degree of uncertainty, the findings also support the previous strategic decision making and decision making under uncertainty research where use of intuition has received attention (Agor, 1989a; Eisenhardt, 1989c; Khatri & Ng, 2000; Miller & Ireland, 2005; Sinclair et al., 2009; Tversky & Kahneman, 1974). Thirdly, in previous research, intuition has received considerable research interests concerning managerial decision making (see e.g. Agor, 1985; Dane & Pratt, 2007; Isenberg, 1984; Sadler-Smith & Shefy, 2004; Shapiro & Spence, 1997; Simon, 1987). This dissertation challenges some of the previous findings, for example the difference between senior and junior managers' use of intuition. However, for the most part the findings in this research complement previous research descriptions of decision makers' use of intuition.

The results of this study showed no significant difference between experienced decision makers and inexperienced decision makers in how they used intuition in decision making. This result challenges the previous research where senior managers have been found to use intuition more often than do lower level managers (Agor, 1986, 1989a; Allinson & Hayes, 1996; Khatri & Ng, 2000; Parikh, 1994; Raami et al., 2010). By providing empirical evidence for the use of intuition by experienced and inexperienced decision makers, this study contributes to the discussion of decision making between these different roles in the workplace. The comparison of manager to decision maker could make some differences to the results, but the evidence suggests that in this context, senior manager is equivalent to experienced decision maker and lower level manager is equivalent to inexperienced decision maker.

The study adds empirical evidence not only to the existence of intuition in decision making but also to how intuition appears in decision making cases and how different actors use intuition in decision making as explained by the presented role descriptions of decision makers (drifter, thinker, negotiator, tester, discoverer, believer, seer) (Dane & Pratt, 2007; Pretz & Totz, 2007). The description of roles and their approach to the use of intuition in particular provides new definitions to the intuitive decision making research. The use of intuition can also be seen as a component that is flexible in the innovation process. This is something which has been a requirement in the previous research (Buganza & Verganti, 2006).

Both *cognitively* based intuition (seeing the bigger picture, sense making) and *affectively* based intuition (gut feeling) is needed for effective innovation decision making. A combination of the two original descriptions is referred to as a *holistic* perspective. The holistic perspective acknowledges both aspects of intuition and does not see them as conflicting or exclusive. Instead, the holistic approach sees both sides of intuition as working simultaneously even though they are separate cognitive systems (Dane & Pratt, 2007; Hodgkinson et al., 2008; Sinclair et al., 2009). This study contributes to this discussion by defining the roles of intuition and the links that those role descriptions have to the three aforementioned intuition definitions.

5.2.2 Contribution to intuition research instruments

Intuition as a phenomenon is a challenging research object. This is because the use of intuition is not necessarily visible in the people's actions. Individuals do not always know or recognize the use of intuition. Some might even deny having used intuition in decision making because it is not regarded as a reliable tool as rational decision making models. There are several quantitative and survey questionnaire based research instruments which are constructed as self-tests (Allinson & Hayes, 1996; Epstein, 1990; Epstein et al., 1996; Forgas, 1995; Hodgkinson & Sadler-Smith, 2003a; Sinclair et al., 2009). The Rational-Experiential Inventory (REI) survey questionnaire, which is based on the Cognitive Experiential Self Theory (CEST) was used in this study (Epstein, 1990, 1994). The results of the survey questionnaire and the factor analysis support the previous findings by e.g. Sinclair et al. (Sinclair et al., 2009) that the reliability of the Rational Experiential Inventory (REI) is questionable. The modified REI factor model that was used in this study was able to show the ability to use the intuition and a preference for the use of intuition (engagement) in the decision making as was predicted. In that way it partially supports the use of REI as a survey instrument for the study of intuition.

The qualitative research approach and grounded theory method that was used in this research as the main method, was found to be explanatory and usable tool for the study of the use of intuition. This is because it allows for and even requires an interpretive analysis phase. This phase helps in making sense of what happens and is sometimes unstructured and difficult to analyze in intuitive decision making (Charmaz, 2006; Miles & Huberman, 1994).

New research instruments can be built on based on the categorization of roles in this study and thus provide a better understanding of the use of intuition in decision makers' behavior. This could open up intuitive decision making to further research and help in building new ways of fostering and developing managerial and organizational skills in this area. The "four faceted intuition frame" could be used as a framework to study the use of intuition in different contexts and research set-ups.

5.2.3 Contribution to innovation management research

The innovation management and NPD literature in particular has used three perspectives to discuss innovation management: environmental, individual and organizational (Cooper & Kleinschmidt, 1995; Kleinschmidt et al., 2007; Reid & de Brentani, 2004; Trott, 2005). The findings of this study add a new dimension to those descriptions (see also Table 2.7) by positioning the findings of the use of intuition in decision making (symptoms, preceding enablers, simultaneous enablers, safeguards and roles) to the perspectives as shown in the Figure 5.1.

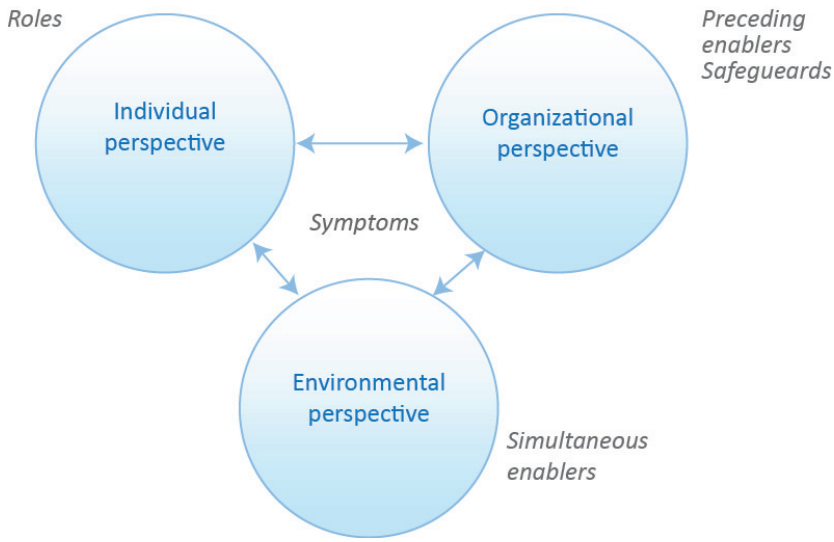

Figure 5.1: The appearance of intuition (*in Italic*) in innovation management perspectives

The symptoms provide an indication that intuition is being used at front end decision making. The preceding enablers and safeguards are process-level items which can be used in the development of organizational processes (Cooper, 2008; Khurana & Rosenthal, 1998; Reid & de Brentani, 2004). Simultaneous enablers are characteristics related to the organizational environment which could be taken into account when making an organization more intuition friendly (Christensen & Raynor, 2003; Eisenhardt, 1989c; Tushman & Anderson, 1987). The findings of this study also contribute and support the findings of Reid and de Brentani that the use of intuition is high

for radical/discontinuous innovations (Reid & de Brentani, 2004). The description of the roles and how they use intuition in decision making complement a category of individual innovation management research (Chakrabarti, 1974; Gemunden et al., 2007; Tushman, 1977; Tushman & Katz, 1980). The role descriptions presented in this dissertation can be compared to the previously defined roles of gate keeper, champion, promoter and boundary spanner.

This study increases the understanding of the innovation front end by revealing the use of intuition in decision making in innovation front end. Uncertainty and complexity is highest during the front end phase (Davila, 2000; Kim & Wilemon, 2002b; Nobelius & Trygg, 2002; Zhang & Doll, 2001) and the findings of this study shows that the use of intuition is also high in that phase. Intuition was found to be an important component of innovation front end decision making based on interviews with experienced decision makers. This study contributes to innovation management research by highlighting the use of intuition as a decision making technique especially at the front end of innovation (Adams et al., 2006; Cooper, 1990; Cormican & O´Sullivan, 2004; Hart et al., 2003; Khurana & Rosenthal, 1998; Krishnan & Ulrich, 2001).

The findings support previous research in the importance of intuition in NPD screening gate decisions (Hart et al., 2003; Tzokas et al., 2004). The results of this study add a new viewpoint to previous results by explaining how the decision makers use intuition in screening gate decisions. This study also concentrates on how senior (experienced) decision makers operate. In previous studies, this was raised as an area requiring further research (Yahaya & Abu-Bakar, 2007).

This dissertation brings new evidence and support to previous NPD (NBD) research concerning the personalities of decision makers (Stevens & Burley, 2003; Van Riel et al., 2011). Stevens and Burley found out that intuitive individuals and intuitive decision making is the most important factor in early stages of the NBD process. They used a MBTI based criteria for evaluating personalities. The results of this dissertation and the role descriptions add on to previous descriptions of the intuitive personality at the front end of innovation. The importance of the experience and the use of intuition of decision makers was highlighted by Van Riel et al. (Van Riel et

al., 2011). The results of this dissertation support and expand upon their work.

The NPD environment has been evaluated as a high velocity and uncertain environment. The use of intuition has been found to be one of the main components in decision making when the environment is turbulent (Dayan & Di Benedetto, 2011). Dayan and Di Benedetto have studied team intuition in particular and the results of this dissertation complement and partially challenge their findings in the sense that intuitive judgment has to be looked at from an individual perspective in order to get a fundamental and more detailed picture of the phenomenon.

By taking a grounded theory approach in this study, it was possible to build a new framework for the use of intuition in the innovation front end with the descriptions of intuitive decision making characteristics ("four faceted intuition frame") in innovation management and with the role descriptions of intuitive decision makers as shown in Figure 5.1. The results of this study show that a qualitative approach is in general one of the most suitable ways to research intuition because it is complex in nature and not explicitly defined. Therefore it is not quantifiable and measurable in the same way as some other phenomena e.g. rational problem solving and decision making.

5.2.4 Contribution to decision making and sense-making research

Managers sense-making and decision making activities are tied to their cognitive frameworks or mental models. Past experiences shape their template for the understanding of future experiences (Weick, 1995). Intuition used in complex environments (as is in innovation front end) is based on experience - cognitive frameworks and mental models (Aaltonen, 2007). The framework is developed based on work and on life experience and education. Frameworks and models are developed over time and through experience and interaction with others (Aaltonen, 2007; Kahneman, 2003b). This study contributes to this discussion by describing mental models (in this study, the approach that the decision makers have) of different actors in the innovation management process and their properties and mental models as specified in Table 4.7.

A systems intelligence approach sees decision making and decision makers in complex environments that are closely engaged to their environments in order to make the right decisions. This study adds to the discussion of how organizations can adopt systems-thinking in their operations (Ackoff, 2006; Hämäläinen & Saarinen, 2008a; Saarinen & Hämäläinen, 2004). This adoption comes from understanding and nurturing the intuitive aspects of intelligent decision making.

5.3 Practical implications

This dissertation is tightly connected with field and practice – the actual work of innovation management. The interview based qualitative and interpretative approach allowed me to get into the challenges of the innovation front end and decision making. Also, my own participation in innovation management ensured a seamless connection with real life practices. In that sense, the results of this study stem from practice and empirical data and observations.

It is clear, based on the findings of this dissertation, that intuition plays a major role in innovation management, especially at the front end phase. Organizations need to recognize the role of intuition and see how it can be best utilized in their respective environments. It is also clear that decision makers in engineering companies operating in NPD are using intuition with mainly positive outcomes. Thus the question for the organizations is how to foster intuitiveness and how to use intuition in the organization.

The use of rational decision making has dominated practices for a long time. Basically the development of all decision making, decision making models and managerial education has been based on analytical and rational models. It is time to explore non-rational decision making models and acknowledge the existence of the use of intuition in decision making in innovation management. It is still to be noted that rationality must have a clear and strong position in managerial decision making, otherwise objectivity, and traceability and likely the reliability of managerial work and decision making is endangered.

At the individual level, the practical implications support individuals to develop and trust their own intuitive abilities and enhance the use of intuition in decision making. The existence and significance of intuition in a successful decision maker was clearly shown in the findings of this study. Again, as noted earlier, intuition must not be used as the sole criteria for decision making instead a holistic aspect that uses both the experience based and affect based intuition complements for analytical decision making.

In the future, complex and fast changing decision making environments will mean that the importance of the sense-making will increase (Aaltonen, 2007; Brown & Eisenhardt, 1997; Eisenhardt, 1989c; Tidd & Bessant, 2009). Traditional, rationally justified, sense making way may not be enough to cope with the fast changing decision making environments. As Aaltonen described, you need to have a second order change in order to respond to change that is occurring in the environment (Aaltonen, 2007). Intuition can be one tool to be used in that second order change.

Despite the fact that the study does not present a straight forward theory or model to develop innovation management practices in organizations, it provides a means of developing the use of intuition in decision making (importance of experience and knowledge and openness to intuition) and it could spark some ideas about how and when intuition is suited to innovation front end practices. At least the existence of intuition is clear and must be recognized by all practitioners.

When organizations are developing their decision making practices they need to first know how intuition is used in their decision making and in what way it is used. By identifying the symptoms and decision makers' decision making methods, organizations can recognize that intuition is used in decision making. If spontaneous decision making, decision based on feelings and visional decision making is found, the use of intuition is probably being used in decision making. Even though the reliability of survey tools to evaluate the individual decision maker was not found to be very high in this research, the use of these tools can help in evaluating the individual preferences and abilities in the use of intuition. Especially as the tools develop, there are fast and easy ways of getting started in developing the use of intuition.

In the following Figure 5.2, some of the means of fostering the use of intuition are described. This can be done by recognizing and developing the enablers and safeguards as was found in this research. Firstly, by increasing the knowledge and experience at a personal or organizational level the possibility for holistic intuition is raised. This is done by using normal training and on-the-job learning practices. It should also be noted that one of the enablers was “clear working practices”. This means that the use of intuition is fostered when organizations already have clear routines and processes in place where they can base normal operations and the choice to use intuition in decision making is given to the individual.

Secondly, by simply recognizing that intuition plays a role – conscious or unconscious - the threshold for the use of intuition is lowered. This can be done by accepting intuition as a valid component of decision making. Common values supporting the use of intuition also play a major role. As was noted in high-velocity decision making situations, sometimes the push in the decision making situation enables decision makers to use intuition. Therefore, building on decision making situations so that time is limited can also foster the use of intuition.

Thirdly, as a safeguard for the use of intuition, possibilities for testing and piloting decisions early enough is also helpful in the use of intuition and maturing of decisions. Different piloting practices and reflective learning practices are helping in that area. The availability of a sponsor for the project or the decision was found to be one component that supports the use of intuition in decision making.

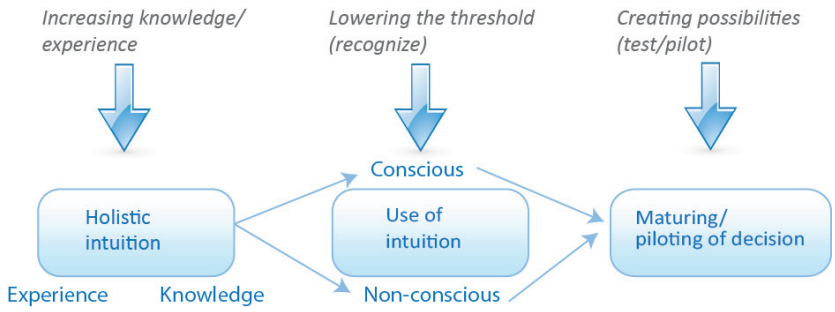

Figure 5.2: The ways to foster use of intuition.

The creation of situations and contexts in the organizations where the use of intuition is made easier could also encourage organizations and managers to use and trust intuition in decision making. One way to do this is by fostering creativity techniques and by having open discussions in organizations about intuition.

Intuition and how companies can make the best use of it in their businesses must not be underrated. This needs to be taken into account at all levels of an organization. During the last years, the use of intuition has been discussed in management literature and most effective ways to use it are constantly being evaluated (Campbell & Whitehead, 2010; Dayan & Di Benedetto, 2011; Kahneman, 2010; Kahneman & Klein, 2009; Raami et al., 2010; Sinclair et al., 2009) .

5.4 Evaluation of the study

The evaluation of the study is done in three phases. This is because the study contains both qualitative and quantitative parts, each of which requires different evaluation criteria. First the overall research setting and the study in general is evaluated. Secondly the qualitative part of the study is evaluated and finally the quantitative part of the study is considered.

To increase the trustworthiness of this dissertation I used a multi-method approach. The main content and the results were derived by using qualitative grounded theory method which was then validated and strengthened

using a quantitative survey questionnaire. I have also kept the entire research process and documentation as transparent as possible in order to give the reader clear view about what has been done and how I ended up with these conclusions of the results that were presented in the results and discussion chapters. The structure throughout the dissertation follows the same logic – from the research questions through literature review and results up to the discussion – to help the reader to follow and judge the contribution of this research.

The selection of the interviewed decision makers and the companies was done in the ICT industry. The ICT industry is generally regarded as a highly innovative high velocity industry and is therefore a good field in which to study innovation decision making. Because of the high velocity, lots of decisions are made all of the time. Due to the speed of change, new innovations are needed constantly. In order to broaden the study beyond the software industry, decision makers from two companies from the telecom sector were included in the interview pool. The selection of four companies with 19 in-depth interviews has provided fairly good coverage of the ICT industry in general. Even though all the interviews were done in Finland and to with Finnish decision makers, the companies operate internationally and thus the results are not limited to the Finnish context. The respondents to survey questionnaire also included non-Finnish participants.

The selection of the interviewees was done using the prime contact in the company. The person was asked to identify a group of experienced persons who have been closely connected to innovation decision making in the company (I was the prime in one of the companies and selected the persons from the company I was working with). The control group for the survey questionnaire part of the study was done by selecting all of the persons involved in decision making that had little experience with decision making. The level of experience was rated based on the job title and the time an individual had been in that position (i.e. lower level managers with less than two years in the position and architect level technical persons with less than two years in the position).

This research used the grounded theory method (Charmaz, 2006; Glaser & Strauss, 1967; Strauss & Corbin, 1998). I have used several techniques in this research as described by Miles and Huberman in order to make sense

of what is happening in the data (Miles & Huberman, 1994). The techniques used and described in the method section of this dissertation includes: Counting, clustering, noting patterns, factoring and categorizing, noting relations between variables, finding intervening variables and building a logical chain of evidence as well as making theoretical and conceptual coherence.

Qualitative research can be evaluated using the criteria presented in detail by Miles and Huberman (Miles & Huberman, 1994). Grounded theory research can be evaluated based on the techniques developed by Glaser and Straus's. Their technique evaluates of how well your constructed theory renders the data by criteria of fit, work, relevance and modifiability (Glaser & Strauss, 1967; Strauss & Corbin, 1998). Other important criteria are discipline in the research process, evidence and aesthetic issues. Criteria presented by Charmaz for evaluating grounded theory studies are (Charmaz, 2006): Credibility, originality, resonance and usefulness.

I have evaluated the qualitative part of this research by using the following criteria: Credibility, usefulness and transferability, originality, confirmability (objectivity), resonance (applicability) and aesthetics.

To increase credibility I have described in detail how the interviews were conducted and how the results were derived from the interview data. Cross tabulation and dependency networks are used to illustrate how the logic of the thought process leads up to the results and conclusions. The interviews were conducted in the interviewees' native language to ensure the accurate interpretations. A second person transcribed the interview recordings to improve the credibility of the interview data. All of the quotes used in the dissertation are translated and available in their original and translated forms. The path from quotes to codes to categories is made clearly visible in the tool used in the analysis (ATLAS.ti, 2006).

It is acknowledged that the interview process between interviewer and the interviewee is always subjective of nature and reflects the both persons' backgrounds. I tried to keep the structure as open as possible without forcing the interviewee along any predefined direction. This was achieved by having lightly structured interview and open ended interview question structure.

Usefulness or transferability refers to the applicability of the findings to contexts outside the original research context. The companies in the study are all NPD oriented. This fact evidently brings one challenge to the transferability of the results. It is clear that NPD engineering differs greatly from e.g. service oriented companies. How much this is reflected in the decision making is not self-evident. In both cases when we look at the early phases of innovation management, there is uncertainty and complexity in play during decision making. If the environment is turbulent there is also a sense of urgency which requires speed in the decision making. In that sense, the decision making contexts may be similar and the findings of this study might be transferable to other industries.

The selection of experienced decision makers for the interviews leaves one handicap in the transferability. The findings, especially the role descriptions, are relevant only to experienced decision makers and cannot be applied directly to for example junior programmers. The presented intuition framework and decision making elements are independent of the role descriptions and can be used in other contexts as well. The only question would relate to transferability limitations between NPD engineering and other types of organizations.

In qualitative grounded theory research the replicability and confirmability are always discussed because of the subjectivity brought in by the selected research method. Instead originality is the criteria presented by Charmaz to evaluate the freshness of the findings and the significance of the work. When evaluating the originality of the results, this study has new and fresh categories and an analysis with new conceptual ideas. It also takes the theoretical presentation of the use of intuition in decision making further. Dependability refers to the replicability of the research process and findings. The same methods that were used to improve the credibility also apply to dependability. The research process and the documentation of the research process and its findings are to support the replicability of the research.

Confirmability or objectivity concerns the neutrality of the research. In qualitative methods, the research is often subjective. This is the case here. The researcher as the main instrument in the research means there is a subjective flavor to the findings. The methods used in interview outlining, tran-

scriptions, systematic coding, testing the initial frameworks with other people increase the objectivity of the research. The results of the study can be said to be confirmable, at least to some extent, because of the discipline and documentation used during the research process.

My own role in one of the companies studied and my previous knowledge in the field of innovation management of course highlights one of the biggest concerns about the objectivity of the findings. I have acknowledged it throughout the research process and tried to deliberately mitigate the possible subjectivity of the findings. On the other hand, I could have used some ethnographic elements in this study since I have been personally involved in the process of innovation front end decision making.

Resonance refers to the applicability of the results. Do the results make sense to the participants? Do the categories portray the studied experience in its entirety? Based on discussions that I had after the analysis with some of the interviewed persons, the results do make sense. The resonance is noticeable. The way the data was analyzed through three consequent encounters was to ensure that the presented categories and the analysis broadly covered in the studied experience.

When it comes to the quantitative part of the study, one limitation is that the instruments are not yet well defined and commonly accepted. This is a problem for all quantitative intuition research (Sinclair et al., 2009). There is still a journey to go when defining the reliable quantitative intuition research instruments.

This study was done in engineering companies which could have effect on the results. Probably the persons working in NPD engineering context are naturally similar to one another independent of their experience or position. This highlights domain specificity as was noted also by Pretz and Totz (Pretz & Totz, 2007). The reduced REI that was constructed in this study should be used for other than engineering related contexts in order to test the generalizability of the modified model.

As noted, the construct validity of the REI was questioned based on this analysis. Similar findings of the REI validity have also been reported in oth-

er studies (Hodgkinson et al., 2008; Hodgkinson et al., 2006; Pretz & Totz, 2007).

The quantitative part of this dissertation plays a smaller, more like confirmatory, role in this study. The evaluation of that part is relatively straight forward and is presented in the relevant chapter of the dissertation. As a summary, the evaluation showed that there are some challenges to the factor model as presented by the REI model. Still it was possible to construct the factor model which had the acceptable level of reliability that is typical when using survey questionnaires.

The criterion discussed above says little about the aesthetics of the dissertation – how the researcher writes and reports the findings and arguments. When evaluating these kinds of issues in particular the subjectivity of the writer can dominate, which is why I am not evaluating it here. Intuition as a concept is a challenging research topic and provides the researcher with flexibility in how he or she reports the findings. This has been found in the previous research in how intuition is used in decision making. Thus the assessment of aesthetic issues is left for the reader to evaluate.

5.5 Ideas for further research

This study has concentrated on a narrow part of the innovation management problematic, the front end of new product development. That is why the study leaves many questions available for further research. The focus on the front end phase of the innovation management process opens up the role of intuition in other parts of the process. Is the launch phase so much different than the front end concerning the use of intuition? Naturally the phases are different, but they share some common characteristics like uncertainty and complexity. The uncertainty and complexity are just of a different nature than at the front end.

Even though I was able to study the innovation front end over a couple of years it leaves open the possibility for some longitudinal aspects of the study. The practices and the organizations need more than a year or two to develop. So the following questions remain unresolved: How do organiza-

tional practices in the use of intuition change when company develops or matures? How does the use of intuition develop in an individual over their carrier? What is the effect of the context on the use of intuition? Each of these questions could spawn an extensive research path. The NPD context itself was also only a narrow view of one kind of engineering company. There are vast numbers of different companies, cultures etc. that still need to be researched.

The role descriptions of this study can be researched in connection with classic team roles (Belbin, 1981; Briggs & Myers, 1962), managerial roles (Mintzberg, 1973) or champion, gate-keeper, boundary-spanner and promoter role descriptions (Chakrabarti, 1974; Gemunden et al., 2007; Reid & de Brentani, 2004; Tushman, 1977) for combined and complete descriptions of the roles acting in the innovation front end. This would increase the understanding of decision makers' roles and of roles in general and help in further developing the decision making practices in innovation management. How do the roles develop over the time would also be an interesting research topic. The results of this study post a snapshot of the role descriptions, some longitudinal elements could have been inserted into the study but that would have required substantially more time in the data gathering phase. Maybe this is just a starting point for the next research journey.

On the methodological side, the instruments used in the study of intuition need more elaboration. The intuitive decision making research path itself has been quite diverse and there is some immaturity of the methods and instruments. This study has contributed significantly, but there is still much to be done. The grounded theory method typically does not produce any formal or grand theory but the results of this study and the research and results of further studies will provide a basis for future theories.

The use of intuition in general needs to be better recognized in education and in research. The courses of study at universities concerning decision making seldom touch on the use of intuition in decision making. Intuition does not easily fit into to prevailing traditional management research discussions. It is likely that intuition and the use of intuition has been, until now, treated as an unscientific area of research and has thus been neglected in the majority of training programs in universities. This is a defect that needs to be corrected.

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7 Appendices

7.1 Appendix A: Bibliometric analysis

To support the literature review and to verify that relevant theory discussions have been taken into account for this study a bibliometric analysis was done. A bibliometric analysis is a semi-automated mathematical methodology used to analyze scientific literature. It is based on the argument that citations and co-citations can be used as indications of present and past activities of scientific work (Garfield, 1983; Osareh, 1996; Small, 1973a). Citation analysis assumes that authors are citing those documents that they consider important in the development of their research. Therefore frequently cited documents are likely to have greater influence on the development of that discipline than those that are cited less frequently. Co-citation analysis records the number of papers that have cited particular pairs of documents.

A bibliometric analysis was done using SITKIS: Software for bibliometric data management and analysis (Schildt, 2005). The analyzed data was exported for further processing in UCINET (Borgatti et al., 2002) and for network drawing to NetDraw (Borgatti, 2002). The time of the analysis was January 2008.

SITKIS is software which uses data imported from ISI Web of Knowledge databases. In this bibliometric analysis the data only contains a social science citation index and used the ISI Web of Science database with the maximum time range available from Helsinki University of Technology (1986-2008).

The co-citation network that was used for the main analysis, and some keyword relatedness analysis was used to verify the most common keywords used in the research area. Co-citation is the frequency with which

two documents are cited together by the later literature (Small, 1973b). To be strongly co-cited, a large number of authors must cite the two earlier papers. The measure is the degree of the relationship between papers as perceived by the population of citing authors. These patterns change over time as the subject field evolves. When two papers are frequently co-cited, they are also frequently cited individually as well. Frequently cited papers represent the key concepts or ideas in a research field. Co-cited patterns map the relationships between these key ideas.

7.1.1 Search patterns

First search pattern

The first search pattern was “decision making AND innovation management”. The search pattern resulted 445 articles. The most cited articles were two seminal articles one from Grant on knowledge based theory of the firm (Grant, 1996) and another from Eisenhardt on dynamic capabilities (Eisenhardt & Martin, 2000).

A co-citation network analysis was done using the parameter for “minimum citations to reference” set as 20. This was done in order to make the network somehow usable, otherwise the results would have been unreadable. No normalization was used for network data creation.

A network graph was drawn using a tie strength value between nodes of 3. The value was set to 3 in order to highlight only the most relevant linkages. The plotted graph is shown in Figure 7.1. The size of the node represents the number of citations.

The most co-cited article was the article on absorptive capacity by Cohen and Levinthal (Cohen & Levinthal, 1990). Other articles with many co-citations were Eisenhardt’s article on agency theory (Eisenhardt, 1989a), Nonaka and Takeuchi’s book on knowledge creating company (Nonaka & Takeuchi, 1995), Rogers articles on diffusion of innovations (Rogers, 1995), Barney’s article on firms’ resources and competitive advantage (Barney, 1991), and Kogut and Zander’s article on the knowledge of the firm(Kogut & Zander, 1992).

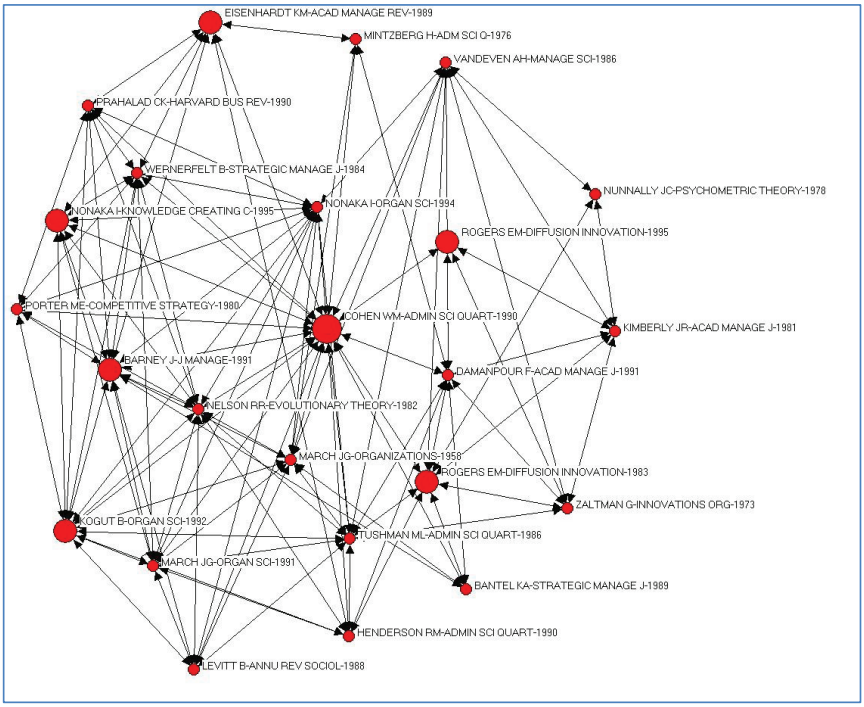


Figure 7.1: Co-citation network of "decision making AND innovation management"

A keyword relatedness network was also processed with the same parameter settings as the co-citation network. The network is shown in Figure 7.2. Strong linkages between the keywords were obvious.

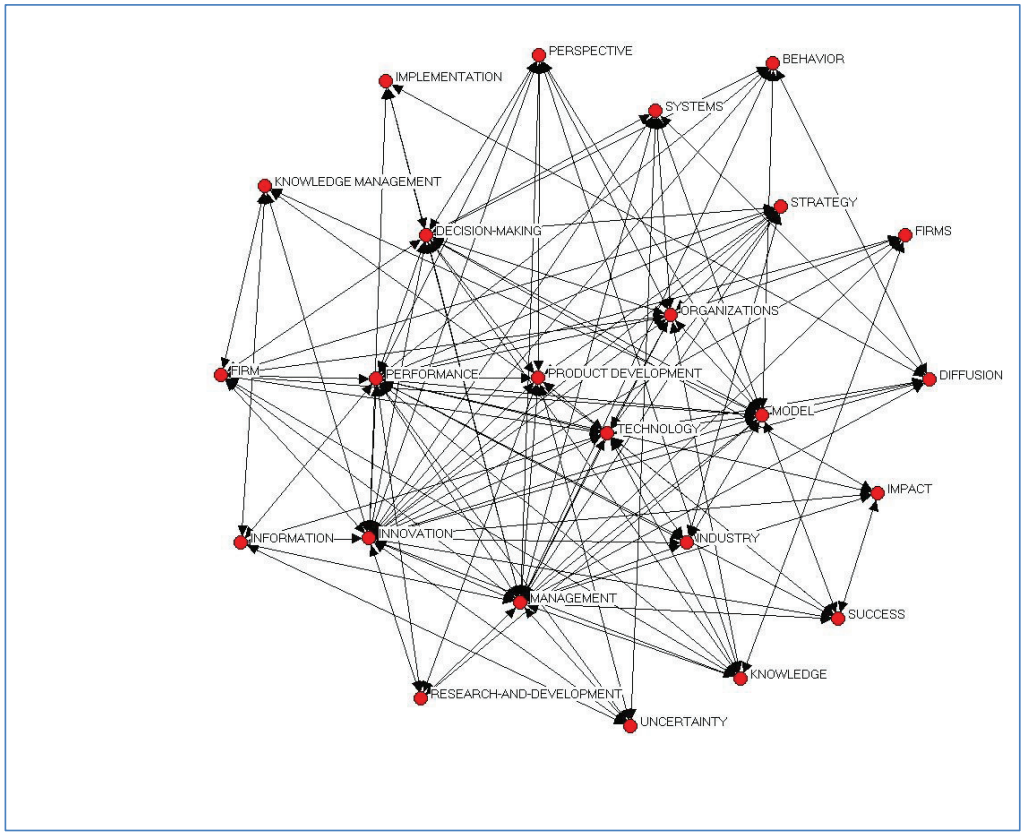


Figure 7.2: Keyword relatedness in search pattern "decision making AND innovation management"

Second search pattern

Second search pattern was "strategic decision making AND innovation management". The search pattern resulted in 122 articles. The most frequently cited article was again Eisenhardt's paper on dynamic capabilities (Eisenhardt & Martin, 2000).

A co-citation network analysis was done using the parameter for "minimum citations to reference" set as 10. No normalization was used for network data creation.

A network graph was drawn using a tie strength value between nodes of 1. The plotted graph is shown in Figure 7.3.

The most co-cited article was Barney's article on firms resources and competitive advantage which was among the top co-cited articles in search pattern "decision making AND intuition" (Barney, 1991). The new articles and books not mentioned in the first search pattern are Porter's seminal book on competitive strategy (Porter, 1980), Prahalad and Hamel's article on core competences (Prahalad & Hamel, 1990), Hambrick and Mason's article on upper echelons theory (Hambrick & Mason, 1984) and Bantel and Jackson's paper on top management teams (Bantel & Jackson, 1989).

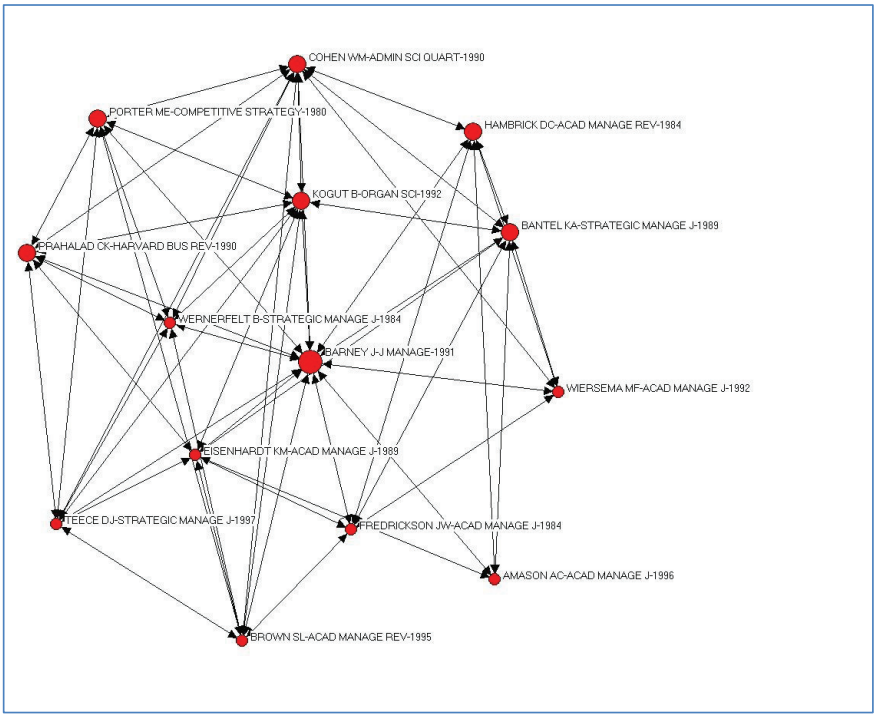


Figure 7.3: Co-citation network of "strategic decision making AND innovation management"

Third search pattern

The third search pattern was "decision making AND intuition". The search pattern resulted 237 articles. The most cited articles was Kahneman's article on judgment and choice (Kahneman, 2003b).

A co-citation network analysis was done using the parameter for "minimum citations to reference" set as 10. No normalization was used for network data creation.

A network graph was drawn using a tie strength value between nodes of 1. The plotted graph is shown in Figure 7.4.

The most co-cited article was Benner and Tanner's article on intuition use by expert nurses (Benner & Tanner, 1987). The other co-cited article was Tversky and Kahneman's article on judgment under uncertainty (Tversky & Kahneman, 1974).

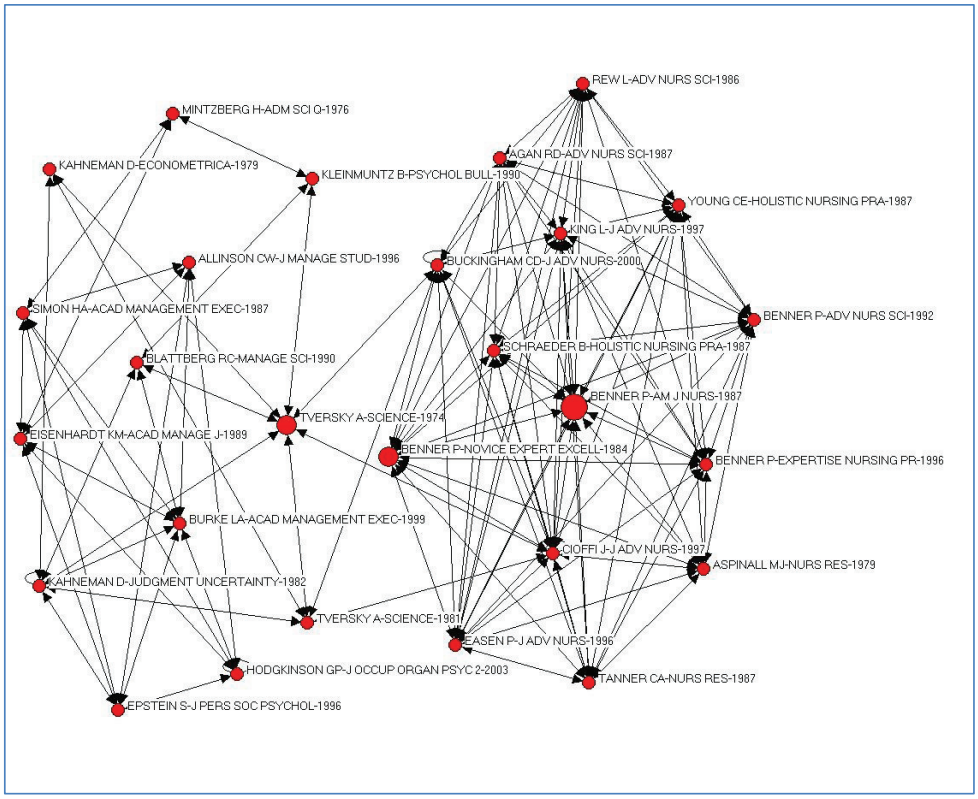


Figure 7.4: Co-citation network of "decision making AND intuition"

7.1.2 Summary

Many of the most recognized studies about competing in the market have been done by Michael Porter. Porter's book on competitive strategy (Porter,

1980) highlights the importance of innovations when competing in the marketplace.

Prahalad and Hamel's article on core competences (Prahalad & Hamel, 1990) describes the competences inside the company as one of the key differentiators between successful and unsuccessful companies. Innovations and innovation management can be one of those core competencies.

The absorptive capacity of the companies has been researched by Cohen and Levinthal (Cohen & Levinthal, 1990). Barney's article on firms' resources and competitive advantage (Barney, 1991), and Kogut and Zander's article on knowledge of the firm (Kogut & Zander, 1992) as well as Nonaka's research on knowledge creating companies (Nonaka & Takeuchi, 1995) all touch on the way in which companies create and absorb a competitive advantage by creating new knowledge and innovations.

These paths have been further studied by Grant in his knowledge based theory of the firm (Grant, 1996) and Teece (Teece, 2007; Teece et al., 1997) as well as by Eisenhardt and Martin in their dynamic capabilities research (Eisenhardt & Martin, 2000).

The bibliometric analysis did not produce any surprising results. It further strengthened the importance and relevance of the key documents and discussions in innovation management, strategic decision making, decision making and the intuition field. The results also revealed that a considerable part of intuitive decision making research that is done is related to nursing and medicine.

The limitations of this bibliometric analysis are mostly related to the bibliometric data used in the analysis. The database that was used (ISI Web of Knowledge) is very extensive, but it includes only one set of literature for the whole research area. The marginal publications are not typically present in ISI. However the ISI database includes all of the major quality publications and the results can be considered trustworthy.

7.2 Appendix B: Survey questionnaire used to collect data on experienced and inexperienced decision makers' use of intuition

Survey questionnaire modified based on Epstein et al. (Epstein et al., 1996).

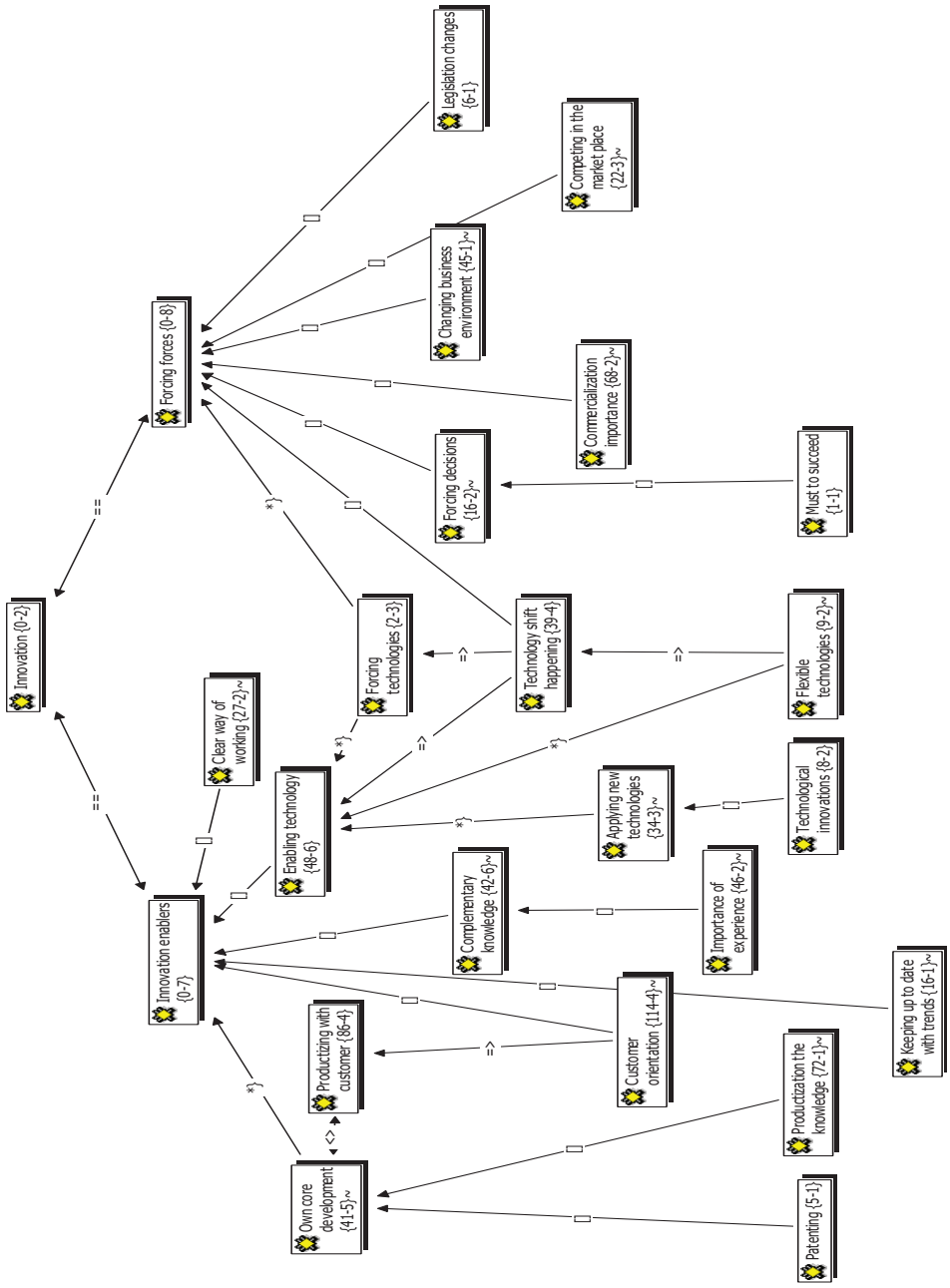
Completely false 1	2	3	4	Completely true 5
( )	( )	( )	( )	( )

1. I have a logical mind
2. I prefer complex problems to simple problems
3. I believe in trusting my hunches
4. I am not a very analytical thinker
5. I trust my initial feelings about people
6. I try to avoid situations that require thinking in depth about something
7. I like to rely on my intuitive impressions
8. I don't reason well under pressure
9. I don't like situations in which I have to rely on intuition
10. Thinking hard and for a long time about something gives me little satisfaction
11. Intuition can be a very useful way to solve problems
12. I would not want to depend on anyone who described himself or herself as intuitive
13. I am much better at figuring things out logically than most people
14. I usually have clear, explainable reasons for my decisions
15. I don't think it is a good idea to rely on one's intuition for important decisions
16. Thinking is not my idea of an enjoyable activity
17. I have no problem thinking things through carefully
18. When it comes to trusting people, I can usually rely on my gut feelings
19. I can usually feel when a person is right or wrong, even if I can't explain how I know
20. Learning new ways to think would be very appealing to me
21. I hardly ever go wrong when I listen to my deepest gut feelings to find an answer
22. I think it is foolish to make important decisions based on feelings
23. I tend to use my heart as a guide for my actions
24. I often go by my instincts when deciding on a course of action
25. I'm not that good at figuring out complicated problems
26. I enjoy intellectual challenges
27. Reasoning things out carefully is not one of my strong points
28. I enjoy thinking in abstract terms
29. I generally don't depend on my feelings to help me make decisions
30. Using logic usually works well for me in figuring out problems in my life
31. I think there are times when one should rely on one's intuition
32. I don't like to have to do a lot of thinking
33. Knowing the answer without having to understand the reasoning behind it is good enough for me
34. Using my gut feelings usually works well for me in figuring out prob-

lems in my life
35. I don’t have a very good sense of intuition
36. If I were to rely on my gut feelings, I would often make mistakes
37. I suspect my hunches are inaccurate as often as they are accurate
38. My snap judgments are probably most as good as most people’s
39. I am not very good at solving problems that require careful logical analysis
40. I enjoy solving problems that require hard thinking
41. What is your accumulated working experience?
42. How many years have you been in your current organization?
43. What is your highest education?
44. What is your education discipline?
45. What is the area in which you are currently functioning?
46. What is your job title?

_____

7.3 Appendix C: Coding network which resulted after the first encounter of the data



7.4 Appendix D: Cross tabulation of the interviewed persons and the codes used in the analysis

C1P3	C1P2	C1P1	C2P5	C2P4	C2P3	C2P2	C2P1	C3P5	C3P4	C3P3	C3P2	C3P1	C4P6	C4P5	C4P4	C4P3	C4P2	C4P1	
×																			Cross func
×	×	×																	Criteria based
						×													Back-up
×																			Finding
							×												Need fro room
							×												Personal dedic
							×		×										Problem solving
		×					×												Technological
		×				×													Compl. Int.
				×															Forcing dec
					×	×													Cost reduction
	×		×																Sponsor need
							×												Innovativeness
×	×	×			×			×											Clear way
	×			×															Good relations
		×	×		×														Trends
×									×	×									Learning by doing
									×	×									Simple
		×	×	×			×	×				×							Experience
		×			×		×					×							Analysis
×	×	×	×		×			×	×		×	×							Feeling
×					×				×	×	×		×				×		Process
			×	×	×		×	×	×		×	×	×		×				Commersializ.
×	×	×	×	×			×						×		×				Compl. knowl.
			×					×	×	×	×								Ind. decision
			×			×			×										Prioritization
			×			×				×	×	×				×	×		Spontaneous
					×													×	Competng
					×			×	×	×	×	×	×	×	×	×	×	×	Productizing k.
	×	×	×		×			×	×	×	×			×		×	×	×	Group dec.
×						×				×	×	×			×	×		×	Common und.
×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	Customer foc
			×			×	×			×					×		×		New tech
			×			×			×	×	×	×							Own core
			×	×	×		×			×						×	×	×	Enabling tech
												×			×			×	Expanding
			×	×	×					×	×		×				×		Changing env
			×	×	×				×	×	×	×	×		×		×	×	Productization
				×	×				×	×	×	×					×		Technology
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