



KTH Machine Design

Decision Making in Innovation

Understanding selection and prioritization of
development projects

ERNESTO GUTIÉRREZ

Licentiate thesis
Department of Machine Design
Royal Institute of Technology
SE-100 44 Stockholm

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<i>Abstract</i> <p>This thesis has its origin in empirical evidence. Some Swedish companies claimed that despite having plenty of proposals for developing new products, they experienced problems when choosing from all those alternatives. Their problem was how to select among new ideas the ones for being developed and the ones to be rejected, how many projects to run according to their capacity, when to start a development project and when to stop one, and how to decide among ongoing projects which the most important ones were. The companies' problem was decision making in the context of innovation.</p> <p>According to literature, a deeper understanding is needed of the decision making process in innovation, taking into account its organizational and procedural complexities. The purpose of this thesis is to achieve an understanding of the decision making process in innovation. The thesis is based on an explorative study, with interviews carried out in three companies that have new product development as a core competitive factor. The empirical study focuses on the decisions made for selection and prioritization of different innovative alternatives.</p> <p>As a result of the analysis of the empirical data a conceptualization of the decision making process was developed. Furthermore, it was described the relevant problems that decision makers experience, the main characteristics of the decision making process and the role that decision making plays in innovation. The implications of these findings for designing work procedures to support decision making in innovation were discussed; and general descriptions of two practical methods suggested.</p> <p>The main findings indicate that for making decisions in the context of innovation, organizations must be able to face uncertain and ambiguous situations, and achieve a collective understanding about what is to be done. To do this, different approaches for making decisions and understanding innovation are needed. However, regardless of the appropriateness of these approaches, they receive different levels of acceptance within organizations; and decision makers must deal with the different grades of organizational acceptance of the different approaches. As a consequence, an organization displays certain dynamic using different approaches for making decisions and for understanding innovation. Such dynamic influences the companies' innovative potential and the output of the innovation process.</p>			
<i>Keywords</i> Decision making, innovation, product development, project selection, project portfolio management		<i>Language</i> English	

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1 Introduction

This thesis has its origin in empirical evidence. Some Swedish companies claimed that they were experiencing problems in their attempts to create new products. Surprisingly, their problems were not related to their capability for generating new ideas. They had plenty of proposals and opportunities for new products, new technologies and new markets. On the contrary, their problem was how to choose from all those alternatives. Their problem was not the lack of new ideas but how to judge which ideas would be the best future products. It was not being short of project proposals but rather how to decide how many projects should be run according to their capacity. They faced problems in deciding when to start a development project and even more problems in stopping an already ongoing project. And if something unexpected occurred and resources had to be reallocated, they faced problems in prioritizing between projects and deciding which the most important ones were. The companies' problem was decision making in the context of innovation.

The development projects that are run today are the products of tomorrow, so people making those decisions are determining the future of their companies. Moreover, innovation often requires big investments that mean an important financial risk for companies. However, deciding to develop a new product just focusing on the short term financial return or on just one type of technology may lead to a weak competitive position in the future (Dawidson, 2006). Christensen (2007) describes how some leader firms lose their positions not because of a lack of organizational capability to cope with technological change, but because of which technologies they decided to prioritize and which they decided to reject.

What's more, researchers have described these decisions as difficult to be made and representing a struggle for decision makers. One reason is because innovation means newness. Thus, as a difference of decision making in other contexts, in innovation the object of the decision is not "what is", but what "might be". The new product that an idea or a development project represents does not yet exist (Cooper, 1998). Thus, the most important decisions in innovation are made before relevant knowledge is available (Moensted, 2006) and based on very unreliable information (Cooper, 1998). Besides, companies usually operate in a multi-project environment with several development projects belonging to different product lines and business units, running in parallel. That means multiple interests represented for different people and internal competition for resources that puts the decision maker under strong pressure from various interest groups (Jolly, 2006). In addition, making trade offs between projects and ideas becomes difficult because of interdependencies among projects, multiple decision makers involved, and many different criteria to take into account (Dawidson, 2006, Archer, 1999).

In accordance with the initial empirical observation of this study, other authors have shown that many companies are still unsatisfied with the performance of their decision making process in innovation. Thus there is still much room for improvement in how the decision making process is practiced (Dawidson, 2006, Jolly, 2006). Some research areas have proposed work procedures for the selection and prioritization of ideas and projects for developing new products. However, these contributions are considered to have been made on a rather general level, based on simplistic explanations and without an understanding of the complexity of the organizational problems implied (Dawidson, 2006, Engwall, 2002). According to Dawidson, some aspects of decision making in innovation appear as poorly explained and unsupported as: why decision making often does not work as it is prescribed in the literature; how decisions really are made; and which processes, functions or actors are involved in the decision making process.

Thus there is need of a better understanding of decision making in innovation taking into account its organizational and procedural complexities. Furthermore, there is a need for work procedures to support selection and prioritization of ideas and projects for developing new products, that are based in a deeper understanding of the phenomena (Dawidson, 2006, Engwall, 2002).

Consequently:

This thesis investigates how decisions are made in the context of the selection and prioritization of innovative alternatives within industrial companies. The purpose is to achieve an understanding of this decision making process through an explorative approach and based on decisions makers' own experience.

It is based on an explorative study, with interviews carried out in three companies that have new product development as a core competitive factor. The interviews focused on the decisions that are related to the selection and prioritization of different alternatives for innovation, in particular:

- Evaluating new ideas and selecting the ones that are judged as good.
- Deciding to start and to stop development projects.
- Deciding the long term plans for product development in the form of visions, roadmaps and forecasts for products, technologies and markets.
- Deciding a prioritization rank among ideas and projects.
- Deciding allocation of resources among projects.

This thesis is built on the results of the empirical study. Its theoretical path is presented as follows: to define a research domain and stating research questions, literature in majority of normative character was used, presented in chapter 2. The results of the empirical study are conceptual categories and explanations generated from information collected in the interviews, presented in chapter 5. Guided by the conceptual categories generated in the empirical study a literature study was carried out. This literature study was used to develop further the categories and explanations made in the empirical study, as presented in chapter 6. As a synthesis of the empirical results and their posterior development, a conceptualization of decision making in innovation was done, presented in chapter 7.

1.1 Definition of central concepts

To put the purpose of the thesis into context, it is considered important to define what it is meant by Innovation, Decisions and Decision Making.

Innovation

Innovation, considered as the act of creating something new, in the form of better, more reliable and useful products and services, is considered by most of the research literature as a competitive factor that contributes to the survival and well-being of companies (Fonseca, 2002). Innovation is usually presented as an imperative for companies that operate in today's competitive markets. That is, they have to continuously develop existing as well as new products in order to survive in the long term (Ulrich, 2003).

In this thesis, innovation is considered as the activities within organizations that aim to generate and realize ideas for new products or for the development of existing ones. The definition includes, besides products, the development of services, forms of commercialization and internal processes. Distinction is not made between innovation and product development. Sometimes, the term product development was used, giving to it the same meaning as innovation. Neither a distinction is made between different types of innovations, such as incremental or radical. The term innovation is used as referring to all types of innovations.

Decision and Decision Making

In spite of not been found a definition of decision in the normative literature, it is given a preliminary definition of a decision: a decision is considered a formal or informal declaration of what is to be done that is collectively informed and accepted within an organization. Decision making is considered the organizational process in which people carry out activities that leads to a decision.

1.2 Research questions

The research questions that are addressed in this thesis are:

- What are the most relevant problems, and their causes, that decision makers experience when making decisions in innovation?
- Which are the main characteristics of decision making in innovation, when considered as an organizational process?
- What is the role that decision making plays in innovation, and what is its relevance for the result of the innovation?
- What are the implications of the understanding displayed in RQ1, RQ2 and RQ3 for the designing of work procedures to support decision making in innovation?

In the next section, a general description of the normative literature in decision making in innovation is exposed, research needs stated and the research questions derived from them.

2 Research area and research questions

In this section, a general description of the normative literature in decision making in innovation is exposed, research needs are identified and research questions derived from them. It is not intended to give a deep and broad exposition about the normative literature in decision making in innovation. This literature study has as a purpose to define a research domain and to state a research problem in the form of research questions.

The normative literature in decision making in innovation refereed in this chapter, covers the research areas that focus on understanding and developing work procedures for the evaluation, selection and prioritization of ideas and projects for developing new products. It includes several research areas such as project management, project selection, new product development, multi-project management and project portfolio management.

As a general description of the normative literature in decision making in innovation, it can be said that it mainly asserts that company decision making regarding what ideas and projects to develop is a matter of a priori portfolio composition, planning, and scheduling (Engwall, 2002). Thus an appropriate set of methods and tools, integrated in a formal and sequential decision making process, should lead to optimal decisions (Cooper, 1998, Archer, 1999). If problems arise, they should be solved through more clearly defined strategies, better product planning, clearer information about customer needs, and more systematic selection procedures (Piippo, 1999). Furthermore, some authors point out that decision makers are expected to display particular behavior: they are supposed to work together towards common organizational goals despite having different decision objectives (Tian, 2002, McDonough, 2003); be willing to compromise (Dawidson, 2006); and take into account opinions of different people (Piippo, 1999).

At the same time, some recurrent problems that arise in decision making are also described in the literature. These are presented as either the consequence of the undesirable behavior of decision makers, or the incorrect execution of the proposed models. However, few explanations of the causes of those problems have been presented. The most important of those recurrent problems are as follows:

- Ideas are simply approved and development projects started without considering the available resources, consequences for other projects, or the balance of the whole portfolio of projects (Dawidson, 2006, Engwall, 2002, McDonough, 2003). This results in companies having too many projects for their resources, projects being delayed, and overall project scheduling that fails (Engwall, 2002, Piippo, 1999).

Strong expressions are used to describe this problem, such as “disastrous result” (McDonough, 2003), “resource allocation syndrome” (Engwall, 2002), or “crunch in resource allocation” (Cooper, 2003).

- Though it appears easy to start a new project, it seems to be difficult to stop one. According to Cooper (1998), a project that has been started takes on a life of its own. It is not easy to justify to an organization that an idea must wait, or to stop another ongoing project (Dawidson, 2006, McDonough, 2003, Elonen, 2002), even though its implementation is no longer justified on a business basis (Cooper, 1998). This decision making pattern is harmful and results in too many ongoing projects, lower morale (Elonen, 2002), long development times (Piippo, 1999), and a reduction of a company’s future success potential and competitive advantage (Cooper, 1998).
- Decision makers display even more remarkable patterns of behavior that do not match those assumed in the literature. Managers sometimes consciously promote certain projects to the crisis point, forcing top management to give them high priority (Engwall, 2002). In some cases, influential people arbitrarily select a certain project, called “the pet project of some senior manager” (McDonough, 2003). Furthermore, it was found that development departments may have “hidden agendas”. That is, some people may not accept decisions officially made by formal decision making forums, whilst others carry out projects without management knowledge (Dawidson, 2006).

In summary, the mainstream literature on decision making in innovation has proposed models based on the use of analytical tools and formal processes, and the existence of decision makers willing to compromise and give precedence to overall organizational goals. However, companies experience recurrent problems during the decision making process, problems that are not solved or explained by the proposed models. There is thus a need for a deeper understanding of the whole decision making process, and particularly of the causes of the problems identified (Dawidson, 2006, Engwall, 2002). Therefore, the first research question to focus on in this thesis is related to the problems that decision makers experience:

RQ1: What are the most relevant problems, and their causes, that decision makers experience when making decisions in innovation?

Considering decision making related to evaluation, selection and prioritization of innovative alternatives, there are different opinions about which processes are encompassed in the making of these decisions. However, there is a set of processes that is commonly named in literature as being involved (Archer, 1999, Cooper, 1998, Dawidson, 2006, McDonough, 2003, Piippo, 1999, Reyck, 2004):

- Handling of ideas: the process in which new ideas and opportunities for product development are handled from the moment they arise to when they come to an instance of evaluation and selection.
- Evaluation and selection of new ideas: the process wherein the proposed new ideas are evaluated and decisions are taken regarding their selection or rejection.

- Managing of product development projects: the process in which the selected ideas are to some extent realized, usually in the form of a structured project.
- Comparison and prioritization of ideas and projects: the process that aims to consider the whole group of selected new ideas and already ongoing projects in order to decide a prioritization rank among them, including decisions about stopping or killing projects.
- Development of strategies for product development: the process in which general directives and concrete goals for product development are defined, usually in the form of visions, roadmaps and forecasts for products, technologies and markets.
- Resource allocation among projects: the process wherein the founding of whole projects or partial development activities is realized.

In the literature of Project Portfolio Management (PPM), two models were found (often cited) described in (Archer, 1999) and (Cooper, 1998), that present in a comprehensive way which organizational processes are encompassed in the evaluation, selection and prioritization of ideas and projects, and how they should be organized and carried out.

The first proposal (Archer, 1999) is a sequential model, based on several propositions grounded in PPM literature, which separates the selection of projects into distinct stages. This model suggests, for each stage, which activities should be carried out and which support tools are appropriate to be used. According to the model the main stages within PPM are pre-screening of ideas; individual evaluation of projects; screening of projects; optimization of the whole portfolio considering interaction among projects; and an overall adjustment of the portfolio. This model states that, a company's strategy for product development is a process that should be made before portfolio decisions are made. Concerning resource allocation, some general advice is given about project interdependencies and gradual resource consuming.

The second one (Cooper, 1998) proposes a decision model consisting of three major decision processes: business and product development strategy, product development and portfolio review. The major assumptions of the model are that the strategy development process leads the whole portfolio management, and that stage gate models for product development process are a central part of the PPM process. In addition, the model suggests a three-step action plan: defining the requirements for PPM; designing central parts of the PPM process; and implementing the PPM processes.

The procedural models presented before contributes with a better visualization of the activities that should be carried out and the processes that should be encompassed within PPM. However, according to Dawidson (2006), the research regarding the procedural aspects of decision making in evaluating, selecting and prioritizing ideas and projects, must be considered as not very well developed. Particularly, the first model seems to include all activities of importance for PPM, but it assumes that all decisions are made in a linear logical process. The second model is considered too generally described and with strong assumptions not clearly grounded regarding the role of stage-gate models to support PPM.

Thus, some models have been proposed for explaining and suggesting how to run decision making in innovation as a process. However, they are made on a rather general level and are based on assumptions that are not sufficiently theoretically grounded, and decision making from a procedural point of view is considered not very well developed. An aspect that needs to be further developed is which factors characterize the decision making processes for evaluating, selecting and prioritizing ideas and projects. Consequently, the second research question is:

RQ2: Which are the main characteristics of decision making in innovation, when considered as an organizational process?

The purpose and the research questions of this thesis have both been developed through the use of certain literature. In this literature, it is understood, explicitly or implicitly, what innovation is; what a decision is; and which role decisions play in innovation. It is intended that this thesis has a critical position about the literature that was used for presenting the research purpose and questions, to assure that the results are not influenced by any assumptions that the literature used makes. That entails building an understanding about what decision making is, and what role it plays in innovation based on the results of this research study. Thus, the third research question is:

RQ3: What is the role that decision making plays in innovation, and what is its relevance for the result of the innovation?

The exposition made before about the normative literature in decision making in innovation shows that the models that have been proposed are not based on a deep understanding of the decision making process. Therefore, there is a need for work procedures to support the selection and prioritization of innovative alternatives that are based on a better understanding of the decision making in innovation as organizational and procedural phenomena. Thus, the fourth research question is:

RQ4: What are the implications of the understanding displayed in RQ1, RQ2 and RQ3 for the designing of work procedures to support decision making in innovation?

3 Research methodology

The purpose of this chapter is to give a description of the research methodology used in this study and to discuss it in relation to the domain and purpose of the study. It is intended to discuss whether the chosen research methodology is appropriate to investigate what it was intended to investigate and to answer the questions that were considered relevant. Research methodology includes both the research methods that had been applied in the study and the scientific approach in which these methods rely on. Furthermore, it is presented the appropriate criteria by which the research results are going to be evaluated.

3.1 Description of the domain and purpose of the thesis

Research domain is considered the part of reality that it is investigated. The domain of this study is decision making in the context of innovation within industrial companies, particularly the decisions related to selection and prioritization of innovative alternatives.

Research purpose is considered what it is intended to be investigated in the domain. The purpose is to achieve an understanding of these domain, and give explanations about how it works in reality, through an approach free from previous stated theories and based on decisions makers' own experience.

Thus, three characteristics of the study are able to be extracted from the description of the domain and purpose: a general purpose of *generating an understanding*, through an *explorative approach* and by studying *subjective experiences*. These three characteristics are the ones that are going to be used for analyzing the appropriateness and implications of the research methodology that was chosen.

3.2 Research methods used in the study

This research study was carried out as part of a research project in which three companies participated. The collection of data was made by qualitative and semi structured interviews. Research methods that were considered suitable were inspired by Action Research for the organizing of the participation of the research group and companies, and Grounded Theory as a systematic method for data collection and analysis.

3.3.1 Action Research and Experiential Learning

Three companies were chosen according to the criteria that they would have innovation as a core competitive factor and run their innovation activities in a multi-project environment (see 3.4). Besides the general academic purpose of this research, it was an intended goal to give benefit to the companies by improving their work procedures. Thus, the research project was organized as a network of companies and researchers, in which through a learning process, research results, new work procedures and change were carried out simultaneously. This research method in which companies go through a learning process that gives value to them is inspired in Action Research (Forslin, 1993, 1995, Westlander, 1999), and Experiential Learning (Kolb, 1984).

In the network at least two persons from each company participated besides the research group conformed by four researchers. In network meetings, the main activities that were carried out were: companies' reflection on their own ways of working; share of experience between companies; and discussion of research results. One interesting part of the learning process in network meetings was that companies considered highly valuable to share experiences of their own practices. For example, they shared with others how they handled short term resource allocation, visual methods for short term planning and methods for evaluation of development alternatives.

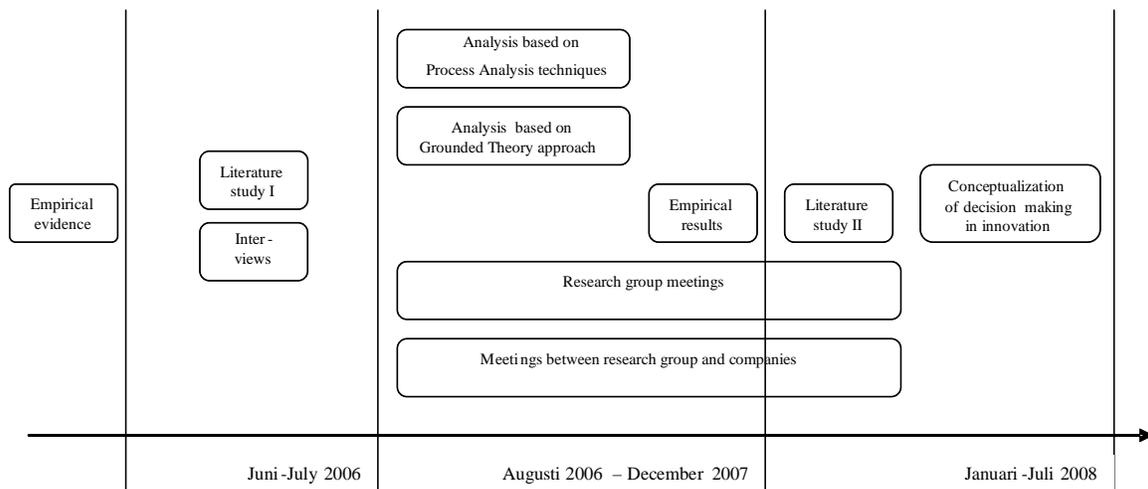
3.3.2 Grounded Theory

This thesis aims to generate an understanding, free from previously stated theories, based on qualitative data and on the subjective experience of the people involved in the phenomena that it is intended to understand. Thus a qualitative approach for systematically analyzing data that is considered suitable is inspired by Grounded Theory. This method is suitable to be used for generating an understanding of social phenomena in an inductive way, based on the analysis of empirical data. It is also appropriate when it is not intended to use existing theories (Hartman, 2001, Gustavsson, 1998). Grounded theory is considered suitable for capturing the complexity of organizational and social phenomena, particularly the decision making process (Locke, 2001). The systematic approach of Grounded Theory that is given in Hartman (2001), Gustavsson (1998), and Locke (2001) is not going to be exposed here. Instead, a detailed description about how the data collection and analysis were done inspired in Grounded Theory is given in 3.5 and 3.6.

3.3 Research study planning

The work was planned in the form of parallel activities. Network meetings between researchers and companies, data collection and data analysis were done simultaneously. The diagram below shows how the analysis of data was done in parallel using different techniques, and how the meetings between the author and the rest of the research group and those between the research group and the companies worked as a way of confirming the interpretations made when analyzing data.

In general terms the diagram shows the approach by which the study was carried out. It started with an empirical evidence about companies experiencing difficulties in the decision making process. A literature study was carried out in order to determine a research domain and purpose of the study. At the same time, interviews were carried out in the selected companies. After that, the analysis of the interviews was made, using different techniques, and parallel the results of the analysis were discussed within the research group and with the companies. A second literature study was carried out based on the results of the analysis. Based in the empirical results and the second literature study, a conceptualization of the decision making in innovation was stated.



3.4 The companies

The main criteria for choosing the participating companies was that innovation had to be a core activity, meaning that the business strategy of each company was based on improving existing products and developing new technologies. In addition, they needed to have several innovation alternatives for choose from, problems in making decisions among those alternatives, awareness about this problem and willingness to change. Three companies were chosen according to these criteria, and a general description of them is as follows:

- Company A develops, produces and sells high-tech machinery for the electronics industry. Their product development requires highly qualified personnel in several disciplines and technological areas. The company has about 500 employees, including more than 100 directly involved in development activities.
- Company B develops, produces and sells machinery for diverse industries, including aerospace and electronics. The products have a medium grade of technological complexity, encompassing mechanical and electronic components and software. The

- company has about 350 employees, including more than 100 directly involved in development activities.
- Company C develops, produces and sells mechanical and electronic solutions for property security. Its products range from low to medium level of complexity. The company has about 1000 employees, including more than 50 directly involved in product development.

3.5 The collection of data

Data collection had a central moment in which the main group of interviews was done. In total, 30 respondents were interviewed, among them general managers, business unit managers, products managers, development managers and project leaders. Interviewees were selected from among those with an active role in decision making regarding the selection and prioritization of ideas and projects. Respondents were asked to talk freely about how certain processes were carried out. Six processes were chosen in the interview guide: Handling of ideas; Evaluation and selection of new ideas; Managing of Product development projects; Comparison and prioritization of ideas and projects; Development of strategies for product development; and Resource allocation among projects. Those processes were initially described by the companies as important and are also named in the literature as relevant for selection and prioritization of innovative alternatives. At least two of the researchers were present at each interview. After that, each network meeting was a source of new information for researchers and a new set of interviews were carried out to evaluate some of the changes which occurred in the companies such as: the implementation of a procedural tool for organizing the decision making process delivered by a consultant firm; a main reorganizing of the internal functions due to a severe downsizing; and a reorganization of the formal decision forums because of an integration of several companies of the same concern in to a common structure.

3.6 The analysis of data

The analysis of data was made continuously and in parallel to the other activities carried out in the research project. That is, at the same that interviews were carried out and network meetings arranged, research notes were taken with the impressions that I got from every information collected and activity in which I participated. The final empirical results are grounded in the analysis of the whole group of interviews, combining different techniques, and discussions taken in meetings with the companies and within the research group.

One approach for the analysis of data was inspired by Grounded Theory. When using this approach some interviews were read, line by line, with the intention of interpreting what the interviewee was saying, beyond the question that was asked to then and the words they used. While asking myself what the interviewee was talking about, I chose codes for labeling the different statements. Coding aimed to give a certain conceptual level that could make it possible to label subsequent statements that were judged as referring to the same issue with the same code. After the first two or three interviews, the list of codes

was relatively large. Afterwards, some codes seemed to have appeared repeatedly whilst others seemed just to appear in individual interviews. Research notes were taken all the time, developing the first interpretations about how the codes could be organized into groups that referred to the same issue. In addition, diagrams were made with post-it notes, for visualizing the codes and how they could be classified in different categories. After seven interviews, the main categories and the relationships to each other had been discovered. The results were confirmed against the reading of ten other interviews, discussions with the research group and with people from the companies. A presentation was made for people from the companies that had been interviewed, and the interpretations discussed with them.

Another approach for analyzing the data was the different techniques for analysis of processes inspired by Sörqvist (1998) and Norling (1994). In this analysis, three different types of diagrams were built up from the empirical data.

The first technique was based on ordering the information of the interviews according to several parameters that characterized organizational processes, such as activities carried out, role of different decision groups, frequency of reviews, etc. Then a diagram was made with post-it notes that intended to visualize the different organizational processes that interviewees referred to. The interpretations that were made about how the decision process worked in reality (regarding interactions between formal and informal processes) were added to the diagram.

The second technique focused on the role of the different actors in each process. The information from the interviews was placed in a double entry chart in which one axle constituted the formal and informal actors that the interviewees referred to as influencing the decision making process. In the other axle the different organizational processes described in the interviews were placed. The chart stated the interpretations about what role each actor played and how they influenced each organizational process, both in formal and informal ways.

The third technique consisted also of a double entry chart in which the different organizational processes were placed in both axles. This diagram displays in each intersection the two different processes and how they interplay, specifically how decisions made in one of them influence the other process.

3.7 Ontological and epistemological assumptions of the study

When a researcher approaches an object of study, he or she does it via explicit or implicit assumptions about the nature of the world and the way it may be investigated. In science there are different opinions about the nature of reality, what is possible to be investigated and how it should be done for being scientific (Burrell and Morgan, 1979). In this section the scientific assumptions on which this thesis relies are presented and their coherence respecting the domain, purpose and research methods of the study discussed. The assumptions that are going to be considered here are of ontological, epistemological and methodological nature.

Ontological assumptions means to assume whether the reality to be investigated is of an objective nature or the product of individual cognition (Burrell and Morgan, 1979). The

domain studied in this thesis implies a social phenomena and it was studied through participants' descriptions of their own experiences. In other words, what was intended to study was how the world is experienced from the point of view of those who lived it. Thus, the reality studied is considered of a subjective character. However, for analyzing data a systematic procedure was used for assuring that the results would be grounded in data minimizing research bias. In that sense, according to Locke (2001), such an approach can be said to assume the existence of an objective reality. Thus, this study is not possible to be classified in just one ontological paradigm. Its ontological position overlaps the assumptions that exists an objective reality in which the results are grounded on, and at the same time that reality is generated in the subjective experiences of people.

The *epistemological assumptions* entails ideas about what forms of knowledge can be obtained. In other words, how one might begin to understand the world and communicate it as knowledge (Burrell and Morgan, 1979). It can be considered that this study assumes a hermeneutical approach, in the sense that the research purpose is to generate a theory that expresses an understanding about how humans interpret their own situation and how they fill it with meaning. This research understanding is achieved through interpretation of people behavior and how they experienced their situation (Gustavsson, 1998, Hartman, 2001).

The *research methods* chosen for carrying out the study implies assumptions related to the way in which it is attempted to investigate and obtain knowledge about the research domain (Burrell and Morgan, 1979). According to the ontological and epistemological position of this study, the research method to be used must make possible to obtain first hand knowledge of the subject under investigation; and in order to understand this subjective world, researchers must be able to participate in it and actively interpret it. An analysis method inspired by Grounded Theory makes possible to fulfill these requirements (Hartman, 2001, Locke, 2001, Gustavsson, 1998). The approach inspired by Action Research for the organizing of the participation of the research group made possible the continuous contact between companies and researchers. Thus, it is considered that the design of the present research study is appropriate.

3.8 Criteria for evaluation of the results

The results of this thesis are evaluated with criteria that are suitable for the scientific and methodological approach of the study. The criteria chosen are considered suitable for evaluating the quality of research results when a Grounded Theory approach is used. It is based on Hartman (2001), Locke (2001) and Gustavsson (1998) and is presented as follows:

Credibility

The reality to be studied is of subjective character and interpretations of data must be made in order to discover the real world behind it. Then, credibility is evaluated through the clarity and grade of detail from which it is shown that the analysis and results are grounded on the empirical data.

Relevance

This criterion evaluates to which extent the researcher has not been influenced by other theories. The risk is missing the discovery of what is really important in the reality that is studied. Relevance is going to be evaluated by describing the extent in which the analysis takes a critical position on the literature used.

Generality

In a qualitative study based on a limited number of companies generalization is not evaluated by a statistical representation in a given population. On the contrary, it is the abstraction level in the building of categories and their relationships that gives the possibility to make several situations understandable beyond the specific empirical material that was used. Therefore, it is evaluated in which extent the conceptualizations in the results make them able to be used for explaining the same phenomenon in other empirical settings.

Results work and are useful

The results should explain what happens in the empirical reality by considering the aspects or problems that are important in the studied context. Results would make it possible for actors to understand and analyze their own situation, make and predict changes and control the consequences of the changes. Thus, the practical usefulness of the results will be evaluated.

4 Summary of appended papers

This chapter presents an overview of the appended papers. The main findings of the papers are stated, and their contribution to the main conceptualization made in this thesis and to address the research questions.

4.1 Paper A

Title: PROBE-Managing the project portfolio for competitive advantage

Authors: Sofia Ritzén, Ernesto Gutiérrez, Jenny Janhager, Gunilla Ölundh Sandström

Main findings: Some areas of importance in which the research study should focus on were identified: characteristics of the work processes of high hierarchical positions in order to see how to integrate them in a formal decision process, conflicts that would arise between different business units when comparing and prioritizing projects, designing of a structured process for handling new ideas without affecting the conditions for a creative environment, minimizing the risk of subjectivity without hindering the contribution of experienced people.

Contribution to the thesis: This paper contributes with the exposition of the research domain and problem. In addition, a research method used in this study is described and its suitability discussed.

Sofia Ritzén conducted the planning and organization of the study; contributed to the analysis and the paper writing. Ernesto Gutiérrez participated in the interviews, made the major part of the analysis, and contributed to the writing. Jenny Janhager and Gunilla Ölundh Sandström participated in the interviews and contributed to the analysis.

4.2 Paper B

Title: Innovation and decision making: understanding selection and prioritization of development projects

Authors: Ernesto Gutiérrez, Gunilla Ölundh Sandström, Jenny Janhager, Sofia Ritzén

Main findings: This paper describes the results of one analysis of the empirical data. It states relevant problems that decision makers experience in the context of innovation. The findings indicate that to deal with all the situations and problems that may arise in the innovation process, various approaches for making decisions and understanding innovation are needed. However, regardless of the appropriateness of these approaches for given circumstances, they receive different levels of acceptance on an organizational plane. This puts decision makers in the conflictive situation of sometimes having to use approaches to work that are appropriate but not accepted, and other times accepted but

inappropriate. Furthermore, an organization's potential to create new products, and consequently its future competitiveness, depends on how its members deal with the organizational acceptance of the approaches used.

Contribution to the thesis: The results and discussion made in this paper constitute the grounds on which the conceptualization of the decision making process is going to be built. It contributes to answers for the research questions 1, 3 and 4.

Ernesto Gutiérrez participated in the interviews, made the major analysis, and the paper writing. Gunilla Ölundh Sandström and Jenny Janhager participated in the interviews and contributed to the analysis. Sofía Ritzén contributed to the analysis.

4.3 Paper C

Title: Designing work procedures for Project Portfolio Management

Authors: Ernesto Gutiérrez, Jenny Janhager, Sofia Ritzén, Gunilla Ölundh Sandström

Main findings: Processes within PPM have five main characteristics: reciprocal influence, parallel running, network of actors, multiple decision levels and decision-realization gap. These characteristics contribute towards dealing with some aspects of decision making on innovation. Procedural models for supporting decision making based on sequential and formal procedures and rational and analytical evaluation tools mean a risk of limiting the organization's innovative capabilities. Thus, researchers aiming to design processes for PPM should be aware of the complexity of the innovation processes, and that the way in which the work procedures are designed, implemented and run is going to influence the output of the innovation process itself. Thus, the understanding of PPM as a process becomes crucial, and the five factors that this paper show becomes necessary for the designing of work procedures for supporting PPM.

Contribution to the thesis: The results and discussion made in this paper constitutes the grounds on which is going to be built the conceptualization of the decision making as a process. It contributes to answer the research questions 2, 3 and 4.

Ernesto Gutiérrez participated in the interviews, made the major analysis, and the paper writing. Jenny Janhager participated in the interviews, contributed to the analysis, and the paper writing. Sofía Ritzén contributed to the analysis. Gunilla Ölundh Sandström participated in the interviews and contributed to the analysis.

5 Results from the empirical study

This chapter presents the results of the analysis of the 30 interviews carried out in the three companies. In section 3.6 a description is given of how the empirical data was analyzed; and in appended papers B and C a thorough exposition of how the results were interpreted from the empirical material is presented. The results are summarized in two separated parts: innovation as a context for decision making and decision making as a process.

5.1 Innovation as a context for decision making

The first result of this study relates to what innovation means as a context for the decision making processes of selection and prioritization of innovative alternatives. Based on respondents' descriptions, an interpretation of the particular and relevant conditions that influences the decision making process in the context of innovation was built up (for a detailed exposition of the analysis and interpretations, see appended paper B).

The empirical material consists of respondents' descriptions about how decisions were made within the selection and prioritization of innovative alternatives. Preliminary reading of the empirical material gave the impression that respondents were giving contradictory descriptions of how the decision making process worked versus how it should work. For example, respondents talked about the importance of planning and forecasting, while concurrently expressing the impossibility of predicting everything. They advocated the use of objective financial figures in evaluating ideas; then some minutes later, they argued for the necessity of subjective judgment. One respondent stated that the existence of written routines was imperative, then immediately explained how ideas are developed informally in coffee breaks. While it was argued that high levels in the hierarchy should make the most important strategic decisions, other stories told of projects starting at low levels without permission. These apparently contradictory statements were coded, in an attempt to discern order. Analysis of the coded material demonstrated that respondents consistently referred to choice in the decision making process. This choice was related to different approaches for making decisions and understanding innovation. The four dimensions of this choice to which respondents referred are described as:

- *Understanding of innovation*: respondents alternated between two approaches to explaining how innovation occurs or should be managed. These were categorized as the static and dynamic paradigms.

- *Rationality in means*: respondents described a choice when making decisions between using rational analytical procedures or non-rational means, such as intuition and “gut feeling.”
- *Formalization of processes*: respondents spoke of a choice between formal and informal processes.
- *Exercise of power*: respondents referred to the organizational hierarchies that participate in the decision making process and the extent to which they influence it. The alternatives were categorized as hierarchical and non-hierarchical.

This classification of approaches for making decisions and understanding innovation is summarized in Table I.

Innovation can be forecasted and planned	Static	Dynamic	Innovation is unpredictable; changes are unavoidable
Analytical procedures that aim to achieve optimal decisions	Rational	Non-rational	Intuition and subjective evaluations; particular interests prevail
Structured and written processes, such as stage-gate models.	Formal	Informal	Meetings and decisions without any written procedure
Highest organizational levels influence decisions	Hierarchical	Non-hierarchical	Decisions made by middle managers without higher approval

Respondents’ descriptions led to the interpretation that different approaches are needed in order to face the different situations that can arise within innovation. In other words, it is the situation that determines if the decision making is more properly approached, for example, by rational models or by intuitive approaches; by formal and sequential processes rather than informal ways of acting. The information from the interviews describing how different approaches contribute for facing different situations that can arise within innovation is summarized in Table II and described as follows:

- Empirical data indicates that understanding innovation in terms of the static paradigm is suitable when information about the environment, ideas and projects is unambiguous and certain. This allows planning and controlling to be done, at the same time which makes people feel safe. However, it leads to frustration when plans are not fulfilled and does not help people or organizations prepare themselves for change. Instead, the dynamic paradigm helps in preparing for change and reprioritizing in a less traumatic way.

- Rationality of means helps decisions become accepted internally, by showing that an optimal decision was made and by communicating the grounds on which it was reached. However, rational methods are unable to solve problems or make decisions when information is uncertain or ambiguous. This situation often arises in the early stages of an idea. In these cases, non-rational means, such as intuition, allow projections and decisions to be made based on the knowledge and experience of a number of people. However, non-rational means have the limitation that they encounter difficulty being accepted because management is unable to demonstrate that they were made impartially or that the best alternative was chosen.
- Formal processes facilitate the control and follow-up of decisions, processes and projects. They also make it possible to ensure that crucial aspects are taken into account when making decisions and prevent strong personalities from making their opinions prevail. Decisions made via formal processes are accepted in organizations, because it is clearly stated who made the decision and what criteria were used. In some cases, for example in the early stages of an idea, an informal approach is chosen because the available information is not suitable to fulfill the requirements of formal models. Thus discussions of an idea to gain the support of key actors are carried out informally outside any formal procedure. Informal processes present the difficulty of communicating how decisions were made.
- High levels in hierarchies apply a perspective that goes beyond particular interests to ensure that decisions are made according to overall organizational goals. Thus, hierarchically made decisions can resolve conflict arising from two business units competing for resources. Non-hierarchical decisions are made when new ideas are considered promising by middle managers. Making decisions lower in a hierarchy allows for more rapid further development, without having to wait for higher-level authorization.

Managing using strategies and plans	Static	Dynamic	Dealing with ambiguity and changes
Achieving optimal solutions	Rational	Non-rational	Facing uncertainty or ambiguity
Planning, control, and follow-up	Formal	Informal	Facing uncertainty or ambiguity
Solving political conflicts	Hierarchical	Non-hierarchical	Rapidly making decisions and supporting new ideas

At that point of the analysis of the interviews, it seemed that the challenge for decision makers is to choose the approaches that are more suitable for use in a given situation. But the empirical material reveals one more aspect that is fundamental for understanding innovation as a context for decision making. To choose which approaches to be used is not easy for decision makers. It is much more complex and conflicting than just considering what is most suitable in a given circumstance. The main reason for this is that despite how appropriate these approaches may be for given circumstances, they receive different levels of acceptance within the organization. The next section describes how this interpretation was drawn from the empirical material.

The respondents' comments presented some ways of working as the "right" ones. At the same time, respondents described situations in which these "right" ways were inappropriate. In these cases, they described the use and appropriateness of other approaches, but other approaches are never described as the "right" ways of working. Moreover, they expressed frustration at the lack of success in using accepted work approaches. Thus, the real conflict decision makers experience arises because some approaches for making decisions and understanding innovation are more accepted in the organization than others. Those approaches that receive a high level of organizational acceptance are assumed to be the "right" way of doing things, regardless of how appropriate they may be in particular circumstances. This puts decision makers in the awkward position of sometimes facing situations in which the approaches to work that they consider appropriate, receive a low level of organizational acceptance.

It was interpreted that a static paradigm for understanding innovation and formal, rational and hierarchical approaches for making decisions, received a higher level of acceptance than a dynamic paradigm and informal, non-rational and non-hierarchical approaches. Of course, the less accepted approaches are used in organizations, but decision makers must deal in some way with the lower level of acceptance. For example, sometimes by-passing accepted and established work procedures; or forcing a decision to go through formal forums despite the fact that the decision has been already made informally. The indicators in the empirical data that led to that interpretation are summarized in Table III and described as follows:

- Respondents spoke of the static paradigm as the accepted way of understanding innovation. Thus forecasting and planning are described as ideal ways of working. Reprioritization and changing plans are presented as undesirable and experienced by respondents as somewhat of a failure. At the same time, innovation is explained in terms of the dynamic paradigm, though this is not described as an accepted explanation; rather, it serves to mitigate anxiety and frustration when plans cannot be fulfilled.
- Rational means and behavior were advocated by interviewees as the right way to make decisions. Non-rational means are allowed to contribute, but only if followed by the use of *rational* means, to facilitate organizational acceptance of the decisions made. For example, some ideas first evaluated by intuition are further developed by avoiding decision gates, or by being presented in terms of optimistic projections. Then, when the ideas reach a certain level of development, a formal decision can be

made via rational means. Moreover, business units influence decision making to defend their particular interests, though this is never depicted in the empirical material as the “right” way of behaving.

- Decisions made in informal ways are at some point forced to undergo formal processes. Respondents described how most of the actors that participate in a formal decision meeting were often involved in the previous informal discussions. As a consequence, many decisions have already been made, and some actions, implying allocation of resources have already occurred, even before they are forced to be considered in formal meetings. In other situations, a formal procedure is not considered the most appropriate way to solve a problem, so some phases of it are bypassed. For example, in early stages of development projects, when ideas are not possible to be defined in a clear way and described by certain information, stage-gate models are largely not put into practice.
- From the empirical material, it appears that it is accepted that higher levels of hierarchies should make strategically important decisions. Despite that apparent acceptance, middle managers complain that they are not allowed to take responsibility for their own decisions. In company A, for example, middle managers resolve this situation by initiating action without waiting for higher-level approval when they consider that a decision is correct. This is not described in the empirical material as the “right” way of behaving, and in practice, at some point, such decisions tend to be validated by a higher level within the hierarchy.

High level of acceptance	Low level of acceptance	
Static	Dynamic	Frustration that arises when plans cannot be fulfilled is mitigated by explaining reality using the dynamic approach.
Rational	Non-rational	Ideas are evaluated intuitively, but rational projections are made to make official decisions.
Formal	Informal	Decisions are made informally and then are taken to a formal forum for official approval.
Hierarchical	Non-hierarchical	Projects are started without official approval when middle managers considered them as promising. Later an official decision is made.

Consequently, innovation as a context for decision making means that different situations and multiple organizational needs require different approaches for making decisions and for understanding innovation to be used. However, despite how appropriate these approaches are for being applied in a given circumstance, organizations display different levels of acceptance of them. Thus decision makers must deal with the conflictive situation of applying approaches that are sometimes appropriate but not accepted, and other times accepted but inappropriate.

5.2 Decision making as a process

This result of the empirical study is related to decision making as a process. That is to say that the focus was on decisions made in different processes, how they were made, and what the consequences of these decisions were. As stated before, the interviews focused on the decisions related to the selection and prioritization of innovative alternatives. To address this, the processes discussed in the interviews were: generating and handling new ideas, evaluating ideas and starting projects, prioritizing projects, managing development projects, developing product development strategies and allocating resources among projects. These processes were chosen because they are considered by the literature and the companies as relevant for the selection and prioritization of innovative alternatives. For a more detailed exposition of the analysis and the interpretations of the empirical data, see appended paper C.

The studied companies have formal processes in which are defined routines and groups of people that are supposed to make the formal decisions regarding selection and prioritization of development projects. However, the analysis of the interviews shown that the formal decision making process, allows to understand just a limited part of how a decision really is made. The decisions for selecting or prioritizing projects are influenced and shaped by a number of decisions that are taken continuously in different processes. More clearly, within the different processes that have been studied decisions are made all the time and these decisions influence which projects are selected or which ones are prioritized.

For example, a problem in one development project might require that more resources are assigned to it. That triggers that decisions must be made in other processes as a review of the prioritization projects, a resource reallocation and a change of strategies. Other examples that might provoke reviewing the list of projects and which are most important than others, are when managers informally assign resources to develop a new idea; or when top management decides to give highest priority to a particular project. An example that shows the reciprocal nature of the influence between processes is when strategies act as guidelines for idea selection at the same time that a new idea that arises, triggers a review of the strategies. That is, decisions are made continuously in the different processes and decisions made in one process affects other processes.

Decisions are not only made in formal decision making processes. Instead, within all the studied processes some decisions are made in a formal way and some in an informal way. Furthermore, decisions are not only discrete points that happen after certain activities have been made. On the contrary, they are made all the time all along the activities that are carried out in each process. For example, in the particular case of idea generation, the empirical study shows that idea generation is not a process in which ideas are generated, and then as a discrete and separate action, a decision is made about the idea. Instead idea generation is a process in which handling, formal and informal evaluations and decisions are intertwined. That makes possible more handlings, evaluations and decisions that finally results in both the idea and the decision about it.

The empirical results shown that in the studied processes, people interact in networks of formal and informal relations and that each person plays different roles in different processes. The same person can sometimes be a formal decision maker and other times an informal actor influencing the decisions made by others. Besides, decisions do not necessarily lead to a consistent action. Instead, decisions made by someone in a certain process can trigger subsequent decisions made by another person in another process. The different decisions are not always consistent with each other and do not always lead to an action.

Related to how a decision could be defined, it was interpreted from the interviews that a decision could be a formal declaration about what should be done or a more diffuse collective understanding about guidelines for action that everyone has agreed on. A statement for the interviews that illustrates this point is “every one had understood that...”.

Consequently, the selection and prioritization of innovative alternatives are influenced by decisions made in several processes. In particular the processes of generating and handling new ideas, evaluating ideas and starting projects, prioritizing projects, managing development projects, developing product development strategies and allocating resources among projects. The general characteristics of these processes and how they interplay is presented in Table IV.

<p style="text-align: center;">TABLE IV General characteristics of the decision processes influencing selection and prioritization of innovative alternatives</p>	
Reciprocal influence	Decisions taken or unexpected events occurring in one process influence the other processes, triggering for example reallocation of resources, reprioritizations of projects or reviews of plans. Influences occur in a two-way direction.
Parallel running	Processes run in parallel and the reciprocal influences are continuously happening, in formal and informal ways and in non sequential order.
Network of actors	People interact in a network of formal and informal relations in which each actor plays different rolls in the different processes. This network makes possible the contribution of different actors, the use of intuition and different perspectives and to balance actors' contradictory interests.
Multiple decisions levels	Decisions are not taken in just one decision moment. There are different levels of decision making for each decision, characterized by decision-groups, grade of detail of the information and the perspective considered.
Decision- realization gap	Not all the decisions have as a consequence that an action is taken or that a resource allocation is made. Sometimes, a decision trigs a large set of decisions that are not consistent to each other or other decisions are never realized.

Summary of the empirical results

Innovation as a context for decision making means that different situations and multiple organizational needs require different approaches for making decisions and for understanding innovation to be used. However, despite how appropriate these approaches are for being applied in a given circumstance, organizations display different levels of acceptance of them. Thus decision makers must deal with the conflictive situation of applying approaches that are sometimes appropriate but not accepted, and other times accepted but inappropriate.

Several organizational processes influences the selection and prioritization of innovative alternatives; in particular the process of generating and handling new ideas; evaluating ideas and starting projects; prioritizing projects; managing development projects; developing product development strategies; and allocating resources among projects. Within all these processes decisions are made all the time, formally and informally, all along the activities that are carried out in each process. The different processes run in parallel and decisions made in one process affect other processes. People interact in networks of formal and informal relations; and each person plays different roles in different processes. Decisions made by someone in a certain process can trigger subsequent decisions made by another person in another process. The different decisions are not always consistent with each other and do not always lead to an action. A decision can be a formal declaration about what should be done or a more diffuse collective understanding about guidelines for action that everyone has agreed on.

6 Discussion of the empirical results

In the previous chapter the results of the analysis of the empirical material has been exposed. In this chapter, these results are going to be discussed as several discussion points. The discussion points are aspects that are considered relevant for further development in order to make a conceptualization of decision making in innovation. In support, of the discussion and the development of the conceptualization, a literature study was carried out guided by the results of the empirical study.

6.1 Innovation as a context for decision making

As previously explained, the empirical results show that innovation as a context for decision making means that people making decisions face different situations that require different approaches for making decisions and, for understanding innovation. From the empirical material, it was stated that two important attributes characterizing different situations are the grades of uncertainty and ambiguity. However, it is considered that these two aspects should be discussed more deeply, due to their influence on how different situations are approached.

6.1.1 Uncertainty

Innovation is understood in different ways by different authors, but there is one aspect of it that most of the authors seem to agree on: innovation involves something new and because of that, there is often a lack of complete and perfect information. Uncertainty is understood as the absence of information (Westling, 2002) and is considered an inseparable attribute of innovation. If everything was certain and transparent and the market mechanism was perfect, no opportunities would be left unexploited (Moensted, 2006). Uncertainty is opportunity and it is embedded in innovation nature (Engwall, 2003). Thus newness and uncertainty are inseparable and are the essence of innovation. It is from uncertainty that new ideas and meanings arise, and innovation is not possible to be understood without it. As Stacey (1998) expressed it: "...that which is truly new is by definition not in the past or the present and so is unpredictable".

6.1.2 Ambiguity

Not having all the information on what is to be done is something that decreases in the course of the development process. As things are done, tests made and data sought, information is achieved and the grade of uncertainty becomes lower. However, there is another characteristic of innovation that also is embedded in its nature but that is not possible to solve by acquiring more and better information: ambiguity. Sometimes, when

creating something new, people face confusion and misunderstanding. It is not clear what it is intended to be done or how to realize it. The new situation, its opportunities and consequences are understood in different ways by different people or not understood at all. This state of confusion and misunderstanding has not to do with the amount or quality of the information but with the way in which the information is interpreted. Ambiguity is not lack of information, it is related to the understanding of the problem and what is intended to be solved (Enwgall, 2003). Ambiguity is confusion. Information is not a solution because frames and interpretations are missing. Under conditions of ambiguity, the activity needed is the one to interpret, frame and make sense of information (Westling, 2002).

6.1.3 Uncertainty and ambiguity in decision making

Innovation, as a context for decision making, implies that decisions are made under conditions of uncertainty and ambiguity. That is, under the lack of information and under the lack of known and common ways for understanding information. Decisions in innovation do not focus on “what is” but in “what might be”, in the form of new opportunities, new products or ventures (Cooper, 1998). Decisions must be made in the whole cycle of the innovations, despite how uncertain and ambiguous the object of decision is. Furthermore, the most important decisions, with the greater implications, are made in the early stages, before relevant knowledge is available (Moensted, 2006). That was described as a paradox (Ullman, 1997), that important decisions must be made anyway, regardless the grade of uncertainty or ambiguity.

Thus, innovation as a context for decision making means that different situations for decisions might arise characterized by different grades of uncertainty and ambiguity. Uncertain and ambiguous situations are unavoidable and different approaches are needed for facing different situations depending on the grade of uncertainty and ambiguity.

6.2 Not only innovation matters

The empirical findings show that the different approaches for making decisions contribute to facing different situations that arise in innovation whilst to fulfilling certain organizational needs. In this section, some organizational needs that influence which approaches are used for making decisions and understanding innovation will be discussed.

One goal that organizations have to fulfill is to carry out diverse operations in an efficient manner. Within innovation, the development of a product, from the stage of idea to a final product in the market, is a central operation. This operation, usually carried out in the form of projects, has to be done quickly and at low costs (Ulrich, 2003). Engwall (2003) states how formal and sequential models for managing development projects (as stage-gate models) contribute to fulfilling several organizational requirements related to the effective management of development projects. For example, they enable people to understand how the activities are supposed to be carried out and give a common language to talk about innovation. This standardizing of work procedures contributes both, to the

organizing of the activities and to achieving stability. In addition, these models allow control of the development projects in relation to usage of resources, planning and intended goals. While these formal and sequential models allow development projects to be carried out in an efficient manner, they do not contribute to addressing some situations that could arise in the innovation process. For example, they are not appropriate to contribute to the challenges faced when developing ideas that display a high grade of ambiguity (Engwall, 2003, Westling, 2002).

Thus these models contribute to fulfilling some of the organizational needs and goals, and to facing some situations within innovation, but not all of them.

Another organizational need is to make the whole way of working legitimate. That is, matching with what the organization's environment understands as the right way of working. The environment could be shaped by the expectations of customers, the competitors' way of working or the rules stated by public authorities or societal values. Some work procedures are put in practice for fulfilling these norms. For example, systematic models for managing product development show to customers that the company is trustable (Engwall, 2003), and are used as signals and symbols of rational behavior (Christiansen, 2005).

Thus some approaches are put in practice to display a certain way of working and not because they are appropriate for being used in the innovation process.

Furthermore, the different ways in which organizations fulfill their various needs and goals also encompasses decisions. That is, decisions themselves are used as means for fulfilling certain needs. According to Brunsson (2002), decisions may have different purposes and sometimes are used as a way of fulfilling contradictory needs. He states that an organization has several needs and goals and they are able to be classified in a continuum in which the extremes are satisfying political requirements, and executing coordinated action. Political acts are used for achieving legitimacy, fulfilling expectations that an institutionalized environment states; while the purpose of coordinated action is the organization of people for carrying out concrete activities. As organizations face multiple and contradictory needs and goals, talk, decisions and actions are used as a way of overcoming it. More clearly, what is said, what is decided and what is done may not be consistent with each other because talk, decisions and actions are used for the purpose of fulfilling simultaneously contradictory goals.

Thus, decisions are not only an activity that has as a purpose that something is done; they are also, an instrument that organizations use for overcoming political conflicts and satisfying legitimacy requirements.

Consequently, innovation, no matter how important an organisation considers it is, has to be managed in the context of the organisation that, at the same time, must fulfil other needs and achieve other goals. These other needs and goals require approaches for making decisions and understanding innovation that sometimes do not contribute to facing other situations that might arise in innovation.

Summarizing, the approaches used for making decisions and understanding innovation do not have just the purpose of contributing to the managing of the innovation process.

Some of them are an instrument for fulfilling other organizational goals and needs that are sometimes not related with the goals and needs of the management of the innovation process.

6.3 Different approaches for different situations and needs

As described in the empirical results different situations and needs require the use of different approaches for making decisions and understanding innovation. In the empirical results the different approaches were classified according to four dimensions: the way of understanding innovation and how it should be managed (static-dynamic); the grade of rationality in the means for making decisions (rational-non-rational); the grade of formalization of the processes in which people interact (formal-informal); and the extent in which different hierarchical levels influence the decisions (hierarchical-non-hierarchical). The contributions of the different approaches for facing different situations and fulfilling different needs were also described. Presented below are several references that describe how different approaches are used for facing different situations, with a discussion about what implies for decision making in innovation.

6.3.1 Rationality in means for making decisions

Rational and analytical approaches

When the necessary knowledge that is required for developing a new idea is available in advance, the development process is able to be managed by linear and sequential models. These linear models consider the innovation process as a rational, predictable series of steps that are carried out in a logical order. Decisions are made by using rational and analytical tools that aim to evaluate an individual project according to the intended goals and resource planning, and a group of projects by aiming to achieve an optimal solution of the mix of projects (Cooper, 1998).

Non-rational approaches

It was described in the results of the empirical study that when the information about an idea or a project is not enough, or if it is not clear how to interpret it, the rational and analytical tools are not suitable. In these cases decisions are taken through non-rational ways. That is, decisions are not based on handling information for considering the best alternatives in an objective way and then, aiming for an optimal solution. In the empirical results some non-rational approaches were identified as the use of subjective and intuitive evaluations, and the influence of particular interests in decisions. Below, some non-rational approaches found in the literature are presented, explaining in which situations they are used. They are ordered as: trust, self-interest and intuition.

- Trust

According to Bower (2007) when there is limited understanding of the object of a decision, the credibility of the person who presents the proposal becomes a determining factor for the decision on it. He states that it is not the words or numbers in the proposal *per se* what determines the decision, but the credibility of the person who takes

responsibility for the proposal. That is, uncertainty is linked to the credibility of the people recommending the proposal (Moensted, 2006).

Thus, under conditions of uncertainty and ambiguity the object of the decision itself, described in the form of goals, functions, profitability, suitability to strategies or other criteria, might not be a determinate factor for that decision. Instead, the credibility that the person sponsoring the idea has among others in the organization becomes more important for the decision.

- Self-interest

Despite how much credibility a person has among others, to explicitly support an idea has its disadvantages, and this is going to affect which ideas are the ones that are presented as good ideas. Bower (2007) states that middle-level managers put their reputation, and often also their careers, at risk, when selecting and sponsoring initiatives. So personal interest (of maintaining a position of credibility and a potential career) influences which ideas are supported, rather than just the company's overall interests. But, how does an individual or a group understand what their interests are? According to Bower, the way in which a business is organized and its managers evaluated and rewarded are factors influencing decision making. He says it in this way: "...middle managers who made the plans for new products, new plants, and new markets thought that the way they were being evaluated, promoted and paid was a clear indication of what top management wanted them to do". The consequence for decision making is that each manager has a particular perspective that prioritizes the success in his or her operating role. Besides, different perspectives may lead to internal politics and power struggles between different business units and, according to Christiansen (2005), in these situations decision makers display non-rational behaviors.

Thus which proposals people are willing to present, support and make a favorable decision on, are influenced by self-interest (individual or collective) and not only by overall benefit to the company.

- Intuition

Under conditions of uncertainty and ambiguity, some people may be able to understand that a proposal could be a good one by combining their experience and knowledge. This approach is called intuition and Sundgren (2004) defines it in the context of new drug development in this way: "...intuition is thinking that uses what is already known, ...to anticipate what is not known and established, negotiated, and agreed on as facts. Intuition is thus thinking that goes beyond or passes what is already known to enable new solutions and findings". He states also that intuition is able to be considered as the capacity to make decisions under time pressure and without complete information. Furthermore, he asserts that, among people working in pharmaceutical innovation, intuition plays an important role in the innovation process and especially in cases in which decision making must deal with a multiplicity of facts. According to Moensted (2006), within innovation it is important to create and to enact a platform for decision that is based on some kind of intuition, and Patton (2003) stresses that confident decision-makers use both logic and intuition.

However, intuition means tacit knowledge. This means that the way in which the judgment is made is based on knowledge that is not able to be expressed to others.

Södergren (2005) describes the role of tacit knowledge in innovation as follows: “When tacit knowledge mobilises we are able to recognize a solution without having formulated the problem yet. We are able also to see the potential of usages that we cannot really express them with words”. For example, Bragd (2002) describes how when developing a new car, a designer judged that in the concept the car had no “charisma”. She says: “How does one know whether a car has a “design charisma”? From a gut feeling, of course. The gut feeling is essential, although it does not rely on the data or hard facts, it is just an intuitive feeling”.

Thus, under conditions of uncertainty and ambiguity sometimes the use of subjective judgments based on the intuition of experienced people is needed. It might be not possible for the people making an intuitive judgment to communicate to others what it is based on.

Thus, when decisions have to be made under uncertainty and ambiguity, sometimes it is not possible to use an objective, analytical and rational approach. A subjective judgment based on the intuition of certain people is then needed, and the credibility of the person making the intuitive judgment is what becomes most important in order for the rest of the organization to accept this subjective opinion. However, the subjective judgments are based on knowledge not possible to be communicated to others and influenced by non-rational behaviours due to self-interest, rewarding systems, power struggles and political conflicts.

6.3.2 Ways of understanding innovation

The empirical results show that the way in which innovation is understood is another dimension influencing how decisions are made. Respondents sometimes explain innovation as static and foreseeable, leading to a way for managing innovation based on strategies, forecasting and planning. Other times, they explain innovation in a more dynamic way in which is not possible to predict the future and, consequently, change of plans and reprioritizations are considered unavoidable. Both ways of understanding innovation are used, and the emphasis is put on one or the other according to the situation that is faced.

In this section it is shown that in the literature on innovation different ways of understanding innovation exists, and they influence which approaches for managing innovation and making decisions are considered suitable. However, it is not intended to give a broad study of all the different ways of understanding innovation that might exist in the literature.

There is no unity among researchers about what innovation is and which approaches should be applied for managing it. For example, Rowland (2004) shows how the epistemological paradigms that researchers choose determine how they suggest that knowledge should be managed; and Jancowicz (2001) states that scientific paradigms influence how tacit knowledge, wisdom and intuition are treated. Fonseca (2002) classifies the literature on innovation in three perspectives that explain what innovation is and prescribe how it should be managed. The first one considers innovation as a rational,

intentional and sequential managerial process and emphasizes strategic choice, planning and sequential models for management of development projects (such as stage-gate models). The second one understands innovation as a social, political and behavioral process and emphasizes the role of the leader and the design and control of conditions that enhance innovation. The third one understands innovation as a potential in all communicative interaction and the focus is put on the quality of participation in ordinary conversations.

Furthermore, the following references discuss the consequences of giving higher emphasis to certain approaches. For example, Engwall (2003) asserts that sequential models of project management can result in good ideas not being selected if they are affected by ambiguity in their early stages. Christiansen (2005) points out the “unintended consequences” that certain models could produce beyond the decision making process. Fonseca (2002) states that models based in the rational planning perspective lead to frustration and anxiety. This is because, from this perspective, to fail in identifying an innovation in advance is due to incompetence. He also asserts that models based on the social and political perspective lead to the creation of a system where people are encouraged to act creatively but according to pre-given vision and values. In that way human freedom is denied by subjecting individuals to systemic imperatives.

Thus the previous before presented references give evidence about the existence of different ways of understanding innovation among researchers. It leads to different ways in which innovation is supposed to be managed and which approaches are emphasized. However, some authors state that no single approach seems to be suitable for coping with all the situations that might arise in innovation.

Summarizing, there are different ways of understanding what innovation is and how it should be managed. However, the approaches that each way of understanding innovation emphasizes are not enough for coping with all the situations that might arise in innovation. If one way of understanding innovation is strongly emphasized, the approaches consequent with it would be also emphasized. Thus the innovation process would be managed in a way in which not all the situations could be handled.

6.3.3 Grade of formalization of processes

The empirical results show that people in organizations use formal processes and meetings as well as informal ways for communicating, exchanging information, and of course making decisions. In this section, different authors are presented that explain why it is not enough to use just the formal or the informal system, and why the interaction of both is what makes it possible to address different situations faced in innovation.

Bower (2007) states that managers just present proposals to top management that they think are going to be approved. That means, that before presenting proposals formally, they use informal channels to pretest their thinking and lobby influential decision makers. He asserts that this practice is well known within organizations and that it reflects a

reasonable use of management time. Furthermore, the central role of informal interactions between people in innovation have been stressed by other authors such as Chanal (2004), who asserts that the most simple and concrete process within any social organization is what people collectively do on a day to day basis, and in particular what they say to each other. Moensted (2006) asserts that when requested knowledge is not known and cannot be foreseen, communication is challenging, particularly dialogues and the gradual sense-making of a vague vision. Problems and solutions cannot be defined in advanced because they grow out of frequent informal communications between the people involved. Christiansen (2007) states that few decisions are made in the formal and official meetings for decision making. Instead, decisions are really made in a myriad of actions, negotiations and micro-decisions within networks of people and non-human actors. In those networks formal and informal relations are established.

The references presented so far stress the importance of interactions between people, communication, language and sense-making within formal and informal structures for facing different situations in innovation. However, the next two references give a much stronger explanation about the importance that formal and informal activities play in innovation by adding one crucial aspect: the dynamics in which the interaction of the formal and informal approaches occur.

Stacey (1998) explains how the dynamics of the formal system (securing day-to-day operations) and the informal system (promoting change) are able to produce at the same time stability and innovation. The dynamics in which both systems interplay for contributing to stability and innovation and change is described as operating at “the edge of chaos”. While some people operate in the formal organization, others operate at the same time in the informal networks. This “chaos” takes the form of political conflicts, clashes of countercultures, dialogue through which ambiguous issues are handled, and learning in informal groups. These interactions are characterized by tensions in which the patterns of behaviour and exertion of power are always different. According to Stacey, this chaotic interaction between formal and informal systems is able to lead to changeability and innovativeness. He states that: “...changeability becomes an internal property of an organization when its informal network system, consisting of self-organizing patterns of connections between people within and across its boundaries, is richly connected enough to operate in the edge of instability, where it produces ever-changing emergent patterns of behaviour”.

More specifically, Westling (2002) proposes a model for explaining how ambiguity and uncertainty are able to be faced and solved through the dynamics of interactions in formal and informal meetings. He asserts that the challenge for organizations is to achieve a balance between individual action and creativity, and collaboration and control. This balance is facilitated by face-to-face meetings. Face-to-face meetings are classified according to two dimensions: their capacity to enhance innovations through addressing ambiguity and allowing different perspectives; and their capacity for creating predetermined behavior. He proposes a model to explain how the dynamics between different types of meetings allows people to face ambiguity via sense-making in informal meetings, and then by facing uncertainty in more formal work meetings where problems

are solved. The model also explains that organizations that do not achieve a correct balance between formal and informal meetings are not able to face ambiguity.

Thus the dynamics in which organisations are capable to combine formal and informal ways of interacting, discussing, communicating and making decisions influences their potential capacity of facing and solving the different situations that might arise in innovation.

As stated in the empirical results (chapter 5) approaches needed to face uncertain and ambiguous situations, besides the formal and informal dimension, presents also different grades of rationality, and extent in which different hierarchical levels influence decisions. The different dimensions do not exclude each other, for example in a formal process, rational or non-rational means could be used, or in an informal process more or less hierarchical decisions could be made. That means that the different approaches for understanding innovation and making decisions are used for facing different situations by achieving a certain dynamics in which they are combined. Moreover, this dynamic is the one that influences the organizational capacity for facing situations that might arise in innovation.

Summarizing, in order to face different situations different approaches for making decisions are used and combined within a certain dynamic. This dynamics in which people in an organisation are able to interact and put in to practice different approaches influences the core organisational potential capacity for facing situations that might arise in innovation.

6.4 Dealing with different levels of acceptance

Thus far, based on the empirical results and the discussed literature, decision making in innovation is able to be summarized as follows. Innovation is an activity that organizations engage in but it is not the only activity. There are a variety of other needs and goals that organization must fulfill that influence the innovation process by requiring that certain approaches are implemented (such as formal, rational and sequential models), functions that have to be operated (such as control) and higher directives and decisions that are not intended to lead to actions. At the same time, within the innovation activity different situations arise that require the use of certain approaches for making decisions and understanding innovation. The organizational capability to coping with the different situations within innovation depends on being able to achieve the right dynamics between the different approaches.

The important question at this point is how to achieve the appropriate dynamic in the use of different approaches. The empirical analysis has shown that despite how appropriate these approaches are for being applied in a given circumstance, organizations display different levels of acceptance of them. Thus people must deal with the different levels of acceptance for the different approaches in order to use the ones more suitable for facing their given situations. In this section, some references are presented, that also state that

some approaches are more accepted than others, affecting in that way the dynamic in which they are used.

Westling (2002) asserts that a manager in complex product development in a situation of great confusion and ambiguity should decrease the number of formal meetings and enhance participation in informal meetings. This is because more structure and control does not decrease the level of ambiguity. He comments that in an internal Ericsson newspaper from 2002 exactly the opposite advice is given. That is, the official discourse in the company was that introducing more structure and control would counteract the state of confusion. Furthermore, several authors have given evidence that planning processes, analytical techniques and stage-gate models are not applicable in conditions of great uncertainty; despite this, they *are* used in just such circumstances (Engwall, 2003, Stacey, 1998). Besides, it becomes difficult to obtain personnel and financing for projects that do not follow structured models (Engwall, 2003). Christiansen (2005) states that actors who make decisions in non-rational ways use the formal stage-gate models to justify such decisions already made and to display rational behavior. Regarding intuition, Sundgren (2004) asserts that, even though it is considered a highly useful human faculty, it is still somewhat controversial to use intuition as the basis for decision making because it is seen as opposing analytical forms of thinking.

Thus, the previously presented references give more evidence that regardless of the appropriateness of the different approaches for given circumstances, they still receive different levels of acceptance at an organizational plane. Moreover, people are forced to deal with this organizational acceptance of the approaches used in order to be able to face the different situations.

Summarizing, different approaches for making decisions and understanding innovation display different levels of organizational acceptance. In order to achieve an appropriate dynamic in the use of the different approaches people must deal with these different levels of acceptance. The organizational capability for facing situations that might arise in innovation is influenced by people's ability for achieving the right dynamic in the use of the different approaches.

6.5 Why are some approaches more accepted than others?

It exceeds the ambition of this thesis to give a deep explanation of why different approaches to making decisions and understanding innovation vary in acceptance at an organizational level, despite how appropriate they are for use in given circumstances. However, it is considered important to present some references that help to infer that this issue encompasses aspects beyond the boundaries of the organizations. That is, some causes of different approaches displaying different grades of acceptance at an organizational level are rooted in societal beliefs, political ideologies and research paradigms.

Brunsson (2007) asserts that rational ways of thinking are highly valued in a societal level and that is regarded as the proper way of thinking. He expresses it as: "In a society

of individuals, we can expect rationality to be a form of intelligence that is accorded high status. In our society, both the theory of the individual and rationality as a form of intelligence are almost always given the status of clearly correct and respectable phenomena; they are parts of the institutionalized reality. People are called individuals, and rationality is seen as being equivalent to intelligence, or at least as being the only proper intelligence. In a secularized culture, it seems more appropriate that the future is controlled by the choices of human beings rather than by God, fate, or chance". When talking about tacit knowledge and its role in innovation, Södergren (2005) presents different authors that assert that it is not widely accepted in society. She talks about a "victory" of the points of view that gives a higher status to the ways of thinking based on the measurable and fragmented versus the ones that are based on more imprecise and holistic ways of thinking. Engwall (2003) states that one reason for explaining why sequential models for managing innovation processes display a high grade of organizational acceptance is that linearity matches with the western world's intuitive way of understanding humanity's historical development.

This analysis is not enough to explain the complex interactions of societal beliefs, political ideologies and research paradigms that influence the dynamic in which the approaches for facing different situations interplay within organizations. However, it allows inference that some approaches are going to display a higher level of organizational acceptance than others, and that some causes of that are rooted beyond the organizational boundaries. The different grades of acceptance force people to deal with it in order to achieve a certain dynamic between paradigms, thus influencing the way in which innovation is managed and its results.

Thus some approaches for making decisions and understanding innovation are going to display a higher level of organizational acceptance than others and some causes of that are rooted beyond the organizational boundaries in aspects related to societal beliefs, political ideologies and research paradigms. This is going to influence the organizational capability for achieving a certain dynamic in the use of the different approaches.

6.6 Decision making as a process

In this section, some references are presented that gives more evidence about some of the procedural characteristics of the decision making process that were identified in the empirical analysis (section 5.2).

From the empirical results, the decision making process related to selection and prioritization of innovative alternatives was described as influenced by several other processes, such as generating and handling new ideas; evaluating ideas and starting projects; prioritizing projects; managing development projects; developing product development strategies; and allocating resources among projects. Furthermore, the different processes run in parallel, and decisions made in one process affects the other processes. People interact in networks of formal and informal relations and each person plays different roles in different processes. Decisions trigger subsequent decisions, the

different decisions are not always consistent with each other and not always lead to an action.

Fonseca (2002) gives an explanation that illustrates how the decision on an idea is embedded in the process of generating the idea. In the idea generation process new meaning emerges within conversations between people. At the same time that people experience the emergent idea, judgments of success or failure are made. That means that in the dynamics of the conversations, not only does the new meaning arise but also the sense among people about the potential benefit of the idea. If anxiety and threat are overcome, and powerful people accept the new meaning, then conversations are able to progress until they become accepted as a new pattern of conversations. In other words, in the idea generation process it is not only an idea that emerges but the decision about the idea. Thus, the process of making a judgment about the idea is intertwined with the process of developing the idea.

In relation to the empirical results that describe the different processes as running in parallel and influencing each other, Bower (2007) gives a similar description concerning the interplay between the strategy process and the resource allocation process. He describes the mutual influence of the strategic process and the resource allocation process as decisions that are taken all the time at different levels occurring in a non-sequential or linear way. Furthermore, he states that small decisions can trigger a sequence of important ones, so it is not possible to determinate which decisions are strategic or not.

Regarding the empirical results that describe decision making as happening within networks of people in which formal and informal decisions are taken, Christiansen (2007) gives a similar explanation and also states the role of the formal decision meetings. He argues that is not possible to understand the decision making process in innovation assuming a priori that the activities and decisions are made in a linear and sequential way. Instead, actions and decisions are made in networks of actors outside the formal meetings that are supposed to make them, he says: "There is not a single mastermind or architect, not a single decision maker, and not one plan or major obstacle to be overcome that will result in everything settling into its final place; rather there is a multitude of processes, relationships and decisions". Christiansen describes the work of the project managers as a building of networks in which the different actors contribute through a myriad of actions, negotiations and decisions. Decisions are in reality made outside the formal meetings and before they take place. Different templates represent the decisions made and act as boundary objects between different networks and the formal decision groups. The formal meetings play the role of stating the guidelines by which the informal decisions should be taken in the networks; check points to control different aspects of the innovation process; and an opportunity for people to show those higher in the hierarchy that work that has been done.

One more aspect to be considered relates to what is going to be considered a "decision". In the empirical results presented previously (section 5.2), it is stated that decisions were interpreted from the empirical material as having different forms. Sometimes a decision was recognized in a formal declaration about what should be done and other times in a

more diffuse collective understanding about guidelines for action that everyone agreed on. Christiansen (2007) refers that some researchers state that what is often called a “decision” might be an artificial construct based on a bureaucratic model where decisions must come before actions, and that in practice, it might happen that actions precede decisions. Bragd (2002) followed the development of a new car during a year. When thinking back about decision making in the development project she says: “At no meeting that I attended had somebody said “now we will decide on this...” How then does the decision-making work? ...Was I sleeping, daydreaming or what occurred during these meetings on decision-making?”. She asserts that traditionally decision making is considered as a black box, in which input is information and output is decision. In the black box, a conscious choice between at least two alternatives of action is supposed to happen. However, she made a different interpretation about how decision making occurred in the development project that she studied. The project team did not need to make decisions but to find a “direction” towards which actions would be started. Decision processes were created for legitimizing actions but in fact action preceded decisions. The direction for actions was achieved by a subtle intuitive tool that Bragd calls rhythm keeping. It gave to the team the feeling that the development process kept pace with the overall corporate development.

Summarizing, decision making is embedded in several organizational processes that run in parallel and mutually influence to each other. In these processes myriads of decisions are taken all the time in formal and informal ways in networks of actors. The formal decision making processes and meetings play certain roles but most decisions are made outside them. Decisions might have different forms, such as a formal declaration taken in a rational way; or a feeling about a direction for action achieved in an informal way. However, it can be said that a decision is the expression of a common understanding between people about what is to be done.

7 Conceptualization of decision making in innovation

As a synthesis of the empirical results and the posterior discussion, a conceptualization of decision making related to selection and prioritization of innovative alternatives is presented as follows:

Innovation is the organizational activity of generating and realizing something new in its more diverse forms, such as new products and services, new ways of carrying out internal activities, new forms of commercialization, new functions in existent products and services, etc.

Within innovation, people interact in diverse forms and achieve a common understanding on what is to be done next. This common understanding is what makes possible the subsequent carrying out of handlings, conversations and actions that lead to a new common understanding on what has to be done next, and so forth. This common understanding on what is to be done is what is called a “decision”.

Innovation as a context for decision making implies that situations of decisions display certain grades of uncertainty (lack of information) and ambiguity (lack of common and accepted ways for interpreting information). To be able to face situations characterized by uncertainty and ambiguity people in organizations must use different approaches for making decisions and for understanding innovation. The different approaches are characterized by certain dimensions such as: the grade of rationality in the means for making decisions; the grade of formalization of the processes in which people interact; and the extent in which different hierarchical levels influence the decision process.

Decision making is considered the process in which people in an organisation interact and achieve a certain dynamic using different approaches for making decisions and for understanding innovation. This dynamic makes it possible to face situations characterized by uncertainty and ambiguity, and to achieve a common understanding on what is going to be done.

This dynamic of using different approaches is affected by the complex group of organizational needs and goals that an organization has to fulfill, and some of them are rooted beyond the organizational boundaries in societal beliefs, political ideologies and research paradigms. Thus some approaches for making decisions and understanding innovation are going to display a higher level of organizational acceptance than others, despite how appropriate these approaches may be for given circumstances.

In order to achieve an appropriate dynamic in the use of the different approaches people must deal with these different levels of acceptance. The organizational capability for facing situations that might arise in innovation is influenced by people's ability for achieving the appropriate dynamic in the use of the different approaches.

Several organizational processes are encompassed in innovation and in all the processes decisions are made. Processes run in parallel, decisions are made continuously in formal and informal ways, and decisions made in one process affect other processes. People interact in networks of formal and informal relations; and each person plays different roles in different processes. Decisions made by someone in a certain process trigger subsequent decisions made by other people in other processes. The subsequent decisions are not always consistent with each other and do not always lead to an action.

In summary, decision making is an organizational process embedded in each activity that is carried out in innovation in which a common understanding about what is to be done is achieved. For doing that, an organization displays a certain dynamic of using different approaches for making decisions and for understanding innovation. For achieving this certain dynamic people must deal with the different grades of organizational acceptance of the different approaches. Furthermore, this dynamic influences the organizational potential to be innovative and the output of the innovation process.

8 Conclusions and future research

8.1 Conclusions

The normative literature in decision making in innovation considers decisions as isolated, discrete acts, made in formal meetings, in which a declaration about what to be done is generated by rational means and leads to a consistent action. This assumption about decisions and the process in which they are taken is not enough to explain how decisions are really made. The conceptualization given in this thesis contributes to an understanding of the decision making process related to selection and prioritization of innovative alternatives that takes into account its organizational and procedural complexities. The implications of this conceptualization are given in the research questions stated in the beginning of this thesis.

- What are the most relevant problems, and their causes, that decision makers experience when making decisions in innovation?

The findings of this thesis have shown that decision making is an organizational process, embedded in each activity that is carried out in innovation in which a common understanding about what is to be done is achieved. For doing that, an organization displays a certain dynamic of using different approaches for making decisions and for understanding innovation. Some approaches display a higher level of organizational acceptance than others, despite how appropriate these approaches may be for given circumstances; and in order to achieve an appropriate dynamic in the use of the different approaches people must deal with these different levels of acceptance.

Dealing with the grades of acceptance of the different approaches to be able to face uncertain and ambiguous situations in decision making is a relevant problem that decision makers experience. The causes of approaches receiving different grades of acceptance are related to the complex group of organizational needs and goals that the organization has to fulfill, some of them are rooted beyond the organizational boundaries in societal beliefs, political ideologies and research paradigms.

- Which are the main characteristics of decision making in innovation, when considered as an organizational process?

Several organizational processes are encompassed in innovation and in all the processes decisions are made. Processes run in parallel, decisions are made continuously in formal

and informal ways, and decisions made in one process affect other processes. People interact in networks of formal and informal relations; and each person plays different roles in different processes. Decisions made by someone in a certain process trigger subsequent decisions made by other people in other processes. The subsequent decisions are not always consistent with each other and do not always lead to an action.

- What is the role that decision making plays in innovation, and what is its relevance for the result of the innovation?

The output of the innovation process is influenced by people's ability to deal with the different levels of organizational acceptance of the approaches for making decisions and understanding innovation, in order to achieve an appropriate dynamic in using the different approaches. Thus how an organization deals with this issue would have consequences for its ability to cope with uncertain and ambiguous situations, and achieve collective understanding. More clearly, the process of achieving an appropriate dynamic in using approaches is an innovation capability. It is an organizational property influencing the potential of being innovative and the result of the innovation process.

- Which are the implications of the understanding displayed in RQ1, RQ2 and RQ3 for the designing of work procedures to support decision making in innovation?

The prescriptive literature on selecting and prioritizing development projects has mainly focused on those approaches for making decisions and for understanding innovation that receive a higher level of organizational acceptance: formal, sequential, and analytical methods; the assumption that the innovation process can be managed through forecasting and planning; and that decision makers display rational behavior. Researchers and practitioners should be aware that these approaches contribute to fulfilling only a limited number of organizational needs and goals, and for facing a limited number of situations that might arise in innovation. Thus an emphasis on certain approaches for making decisions and for understanding innovation might affect the dynamics in which the different approaches are used and could lead to undermining the potential organizational capability for being innovative.

Furthermore, it was stated that some factors affecting the dynamic in which the different approaches are used relate to organizational needs and goals, some of which are rooted beyond the organizational boundaries. Researchers aiming to design work procedures to support decision making in innovation should be aware that the dynamics of approaches and relations is affected by factors that, sometimes, are beyond the control of the people within the organizations.

A general suggestion for designing a work procedure is to start defining which aspect of the decision making process it is intended to support. Then the appropriate approaches for supporting the chosen aspect should be identified. The grade of organizational acceptance of the aspect to be supported and the approaches chosen should be discussed. Thereafter, the design of the supporting work procedure should take into account this internal

acceptance. Finally, the implications of the application of the supporting work procedure to the general dynamic in which other approaches are used should be analyzed.

Based on the results of this thesis some guidelines are suggested for supporting two different aspects of decision making, in the form of two methods: the Process block and the Dynamics block. The methods are described in general terms, and are considered as concepts for the future development of applicable methods. Empirical evidence was also used, such as experiences from a work shop carried out in a company; and practices that the companies that participated in the study implemented and experienced as beneficial. A general description about the purpose and the characteristics of each block are presented here.

The Process block

The Process block is for supporting the development and implementation of a formal decision making process for selection and prioritization of development projects. It aims to guide companies to develop their own work procedure that is suitable for their particular conditions. In other words, the Process block is not a defined work procedure for decision making but a systematic method for developing one. The Process block focus on developing the information flow that is needed between the varieties of processes in which decisions are made. That means that focus is put in maintaining the different actors updated about the decisions made in the different processes.

The structure of the Process block is based on an adaptation of a methodology made for designing and introducing systems for poor quality costing developed by Sörqvist (1998). In this methodology, the design and introduction of the new work procedure is done in the form of a project with active participation of the company's personnel. In that way, people in the organization decide the purpose and scope of the new process and how different people and organizational processes are involved in it. This active participation is what gives the new work procedure internal acceptance and assures it fits with company conditions. The project form guarantees resources will be made available and the work will be assured by carefully planning.

In the Process block are suggested some practices that the participating companies have implemented and experienced as beneficial, such as: visual methods for displaying strategies, innovative alternatives, and the resource allocation between projects; and short and frequent meetings for updating and discussion.

As follows, is suggested in general terms how the Process block should be implemented:

- Organizing the development of the decision making process as a project is recommended. The project form allows systematic organization of the different steps that are needed when developing and introducing a new process; such as achieving support in organization's management, carrying a preparation phase in which analysis of current situations are made, informing all the personnel that would be involved and following up the new work procedure.
- It is suggested that a preliminary study is carried out, in the form of an interview study among people involved in and affected by decisions. The interviews should

focus on how decisions are currently made, and on the problems and opportunities for improvement that each person considers exist. This information is then used for motivating the company's management with regards to the need for developing the work procedure for supporting decision making.

- For stating the scope of the work procedure, identifying and mapping relevant processes and decisions within innovation is recommended. When doing this, it is suggested to consider all the relevant decisions, despite whether they are made formally or informally. As decisions, are considered diverse forms of common understanding as formal decisions, strategic guidelines, resource allocations and actions taken. Furthermore, no assumption is made about the strategic importance of the identified decisions. The processes are visualized in a map in a parallel way, not assuming any sequential interplay between them.
- For defining decision groups, it is recommended to identify groups of key actors in each process that are able to provide a status of the decisions made in the process. The groups are not assumed to be the ones that make the decisions but the ones that are able to give information about what has been decided.
- Define which information each group should need from the decisions made in the other groups. In this Process block, consider just the information flow needed in form of templates. Do not consider in this block the process of interpreting the information. Furthermore, consider simple ways of visualizing the different alternatives and the decision criteria.

The Dynamics block

The Dynamics block is for supporting the informal process in which people, individually and collectively, interpret information for evaluating and making decisions on ideas and projects. It supports the decision making process indirectly, outside the daily business activities. It is not intended to be used for making decisions or to produce any operational output. Instead, it is a method for training and developing the individual and collective capabilities for making decisions. The Dynamics block enhances the potential organizational capability for making decisions in innovation.

The Dynamics block focuses on developing two aspects of decision making: the knowledge structures that people use for understanding information and making judgments; and the social process in which decisions are made.

The Dynamics block is designed in the form of a game. This is based on a work shop made in one of the participant companies and in a literature study, presented as follows.

In one of the participant companies a work shop was carried out which three product managers. They were asked to choose five ongoing projects that were carried out in the company. Then, a hypothetical situation in which two projects had to be stopped was proposed. Their task was to decide a prioritization rank among projects and to choose two to be stopped. First, they just made a verbal discussion. Afterwards, the same task was repeated but allowing the product managers to use different tools such as: financial

calculations, qualitative criteria and visualization charts. As different tools were used, the result of the prioritization changed, and new aspects were considered when discussing.

Regarding knowledge structures Mabojunge (2008) asserts that in decision making under imperfect information, some diffuse knowledge structures influence how individuals view and interpret new material, and which information already stored in their memories is applicable to the new situation. Although these knowledge structures provide structure and reduce complexity, they can also hinder the consideration of certain data outside the interpretive coverage of the knowledge structure. Thus it is needed to improve the conditions for avoiding the influence of habitual patterns of thought.

Concerning the social process in which decisions are made, Stacey (2007) and Fonseca (2002) asserts that innovation and the decisions that make it possible, arises in an informal process that is self-organized; based on conversations, and on negotiation of meaning. Besides, as new meaning creates misunderstanding, anxiety and threat; trust between people becomes a factor enabling overcoming this situation. Innovation emerges in the amplification of the diversity between participants in interactive communication, even when that diversity is quite small. Thus, focus should be put on the quality of participation in ordinary, everyday conversation; what makes people trust each other; and the process in which people make sense of their own engagement with others in the shadow conversations that express deviance.

For enabling the individual and collective development of knowledge structures, at the same time that enhancing the potential capability of people to informally interact and trust to each other, the Dynamic block has the form of a game. According to Mabounje (2008) and Hansen (2008) playing games are recommended for:

- The cognitive benefit of drawing on the imagination to develop new insight
- The social benefit of developing new frames of interaction
- The emotional benefits of providing positive affective associations as well as a safe context in which to take risks, to try new roles, and to explore new potential forms of practice.
- Helps overcoming a situation of different discourses about the definition of a problem
- Facilitates dialogue in conflictive situations based on different perspectives

Furthermore, Carleton (2008) and Mabounje (2008) recommend different ways of communication as physical prototypes, metaphors and theatrical performance for improving the quality of the participation, enhancing the articulation of complex and tacit knowledge, reducing ambiguity, and allowing collective conceptualization and sense making.

As follows, is suggested in general terms how the Dynamics block should be implemented:

- A suggested method is in the form of a game in which situations of decisions are simulated by generating different scenarios. The different scenarios are related to new ideas, changes in the environment, and unexpected problems in ongoing projects

that require reinterpretation of the organizational context before decision making can take place.

- The main goal is playing, without any other purpose than the activity of playing itself. Is this activity of playing that enhances the quality of participation of people in ordinary conversations by connecting them, and allowing them to interplay freely. At the same time, playing enhances the exchange and development of the knowledge structures of individuals and groups by knowing how other people think, and the perspectives they use.
- People are going to interact for interpreting the organizational context in the new hypothetical situation, and making evaluations and decisions on new ideas, prioritizations of projects and resource allocation. In that way, the individual and the collective potential capabilities of evaluating new ideas in different context scenarios is developed.
- It is suggested that the participants in the meeting are chosen randomly from different functions, backgrounds and hierarchies, thus enabling people that do not meet often to interact. People meet outside the daily activities of the company, making it possible to discuss and make decisions in a playful way without the constraints, stress and rationale of the business activity.
- As some evaluations and decisions are based on intuition and tacit knowledge, different ways for communicating are used as physical prototypes, drawings, metaphors and performing.

8.2 Discussion of quality of the results

In section 3.8 the criteria by which the results of this thesis would be evaluated were presented. The results of the thesis are evaluated according to the defined criteria; as follows:

Credibility

Credibility is evaluated through the clarity and grade of detail in which the description of the analysis shows that the results are grounded on the empirical data. In section 3.7 a detailed description is given about how the analysis of the empirical data was carried out. Papers B and C present the information found in the empirical data that led to the different interpretations. During the process of analysis of the empirical data, discussions were held with other researchers within the research group. In addition, discussions with interviewees were taken about the analysis of the empirical material. Hence it is considered that this thesis can credibly defend its results as being grounded in the empirical data.

Relevance

This criterion evaluates to which extent the researcher was not influenced by other theories, and thus missing the discovery of what is really important. This thesis shows a critical position to the literature used for defining the domain and the problem. This is stated in the development of the research questions and in the posterior analysis. However the questionnaire that was used as a guide for carrying out the interviews was partly based on assumptions stated in this literature. In spite of this, the interviews were

semi-structured and gave the possibility for respondents to make descriptions in a free way. In that way the researchers could interpret the answers and build up an understanding. Thus it is considered that the material stated in the interviews made possible to interpret the relevant aspects of the domain and the problem studied. Hence the critical position about the literature used as a starting point, together with the semi-structured character of the interviews, allows this thesis to be considered as having discussed relevant aspects of the domain and the problem studied.

Generality

The results of this thesis are considered as having a certain grade of abstraction. Thus it is considered that the results have a conceptual distance from the empirical data that make them able to be used for explaining the same phenomenon in other empirical settings. However, the empirical study focused on a particular type of decisions (those related to selection and prioritization of innovative alternatives) and was carried out in just three companies. This implies that, despite the grade of conceptualization of the results, they are not able to explain how all types of decisions are made in all types of companies. Consequently, the results should be used as conceptual categories and as a hypothetical explanation of decision making in innovation, but must be validated in other types of decisions and companies.

Results works and are useful

The results of this study have been used for giving the base of practical applicable work procedures for supporting the organizational phenomena studied. In that way it is considered that they work, in the sense that they explain relevant problems, and they are useful for practical applications. However, it is important to remark that the proposed work procedures are presented in general terms and have not been tested in practice.

8.3 Future research

As interactions between people for achieving a certain dynamics of using approaches is considered as an organizational capability for being innovative, more research is needed for explaining how the interplay of different approaches and interactions contributes to address different situations within innovation. Furthermore, better explanations are needed about how the dynamic between approaches and interactions influences the output of the innovation process.

More research is needed regarding the feedback effect that some approaches produce in the output of certain processes. In particular, it is not clear how the design of the process for evaluation and selection of ideas, influences which ideas arise and are selected.

This research study has been grounded in empirical material that focused on a particular type of decision (those related to selection and prioritization of innovative alternatives) and data was collected in three companies. It is necessary to carry out more research studies guided by the conceptual categories and explanations developed in this thesis, in

other types of decisions and companies, in order to take further steps towards a theory for decision making in innovation.

Regarding the design of work procedures for supporting decision making, more research is needed to develop applicable solutions for supporting those aspects of decision making related to informal, spontaneous and self-organized processes. Furthermore, more research is needed to explain the individual and collective cognitive processes in which ideas, projects and the organizational context are understood.

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