A Climate Change towards Exploration

The obstacles to exploration in the context of the organizational climate

Master's Thesis

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Preface

When I obtained a master's degree in Applied Physics, I found a new challenge in the form of the master's program of Business Administration. The change from exact science to social science was quite radical, but it certainly broadened my perspectives about how complex problems can be assessed and what it takes to deal with theories of social science.

Nowadays, almost all companies claim to deliver innovations in the broadest sense of the word, but only few are able to produce innovations consciously and repeatedly. The study track about innovation and entrepreneurship caught my attention since I expected that it could provide insights about the content of the word 'innovation' and how to organize for it. Although the courses of the Innovation & Entrepreneurship track lasted only for six months, I enjoyed learning about the different perspectives on innovation management and the principles of entrepreneurship.

The perspectives on innovation and the assignment at Electro B.V. have shown to be a good combination. It is interesting to determine that typical characteristics of innovation management for large companies were found within Electro B.V., but on the other hand, this thesis offered me a practical experience with the dilemma's that organizations face in daily practices which can not be obtained from theory.

I want to thank my supervisors of the University of Twente Dries Faems and Jasper Veldman for guiding me through this thesis study. I also want to thank my supervisor at Electro, Wilfred Boesveld, who acted as a great motivator during my assignment. I really enjoyed our discussions about innovation, but also about other professional themes like applying for jobs and the importance of networking. This reminds me of a typical statement made by a guest speaker, who talked about leadership during one of the courses. He said that a good leader should have only one characteristic which he described with only three words: 'willingness to connect'.

Finally, I want to thank my family for their support and trust in my abilities to finalize this study within a reasonable time. Thanks to my girlfriend, Mirjam. I can now really appreciate the content and nature of social studies and our discussions about it helped me a lot during the courses and during this thesis. Also thanks to my (future) family in law for the always present interest in the developments during the last year.

Summary

This research was initiated by a part of the management team of the R&D department of Electro B.V. in order to find solutions in becoming a more innovative department. When this research started the innovations of the previous period were incremental and the creation of radical innovations was desired by some R&D executives. From the start of this thesis a focus was put on stimulating innovative behavior by changing the perceptions of the R&D employees regarding innovation.

Within innovation literature, the distinction between exploration and exploitation is made for innovations which are intended to create new technologies and markets on the one hand, and refine and execute more efficient production on the other hand (March, 1991). In order to survive in the long term, researchers believe that a company should pursue both exploration and exploitation. This combination is known as ambidexterity (Duncan, 1976). In this study, the knowledge from this literature stream is used to increase exploration within Electro B.V.

Literature streams which focus on the social aspects of innovation often describe the organizational culture or climate. In order to correctly assess the managerial objectives, this thesis thus combines the literature streams of exploration and organizational climate. Exploration is often related to the outputs of innovation activities. Therefore, the stimulation of exploratory activities, rather than exploration directly, is emphasized in this study. The central question is formulated as:

What changes concerning the organizational climate should be made within the R&D department of Electro B.V. in order to execute more exploratory activities?

The chosen methodology is a case study of Electro B.V. with a focus on the R&D department. The case study allows for multiple data collection methods. Three main data sources are used. First, a survey was conducted among the R&D management and a limited number of executives of the Marketing and Human Resources department. The results of the survey provide a broad overview of the current state of Electro B.V. with respect to innovation. Second, a retrospective project analysis of the project Product 1 was done to determine obstacles to exploratory activities. The project was chosen for its exploratory character. The third research activity is the analysis of a project which was initiated at the start of this thesis. This project was chosen to enable the analysis of the first activities within a project and to assess the current organizational climate.

The results show shared climate dimensions of which several dimensions act as an obstacle to exploratory activities. The most important obstacles are a risk averse climate and a lack of vision. Besides obstacles in the climate, other obstacles to exploration are found. These are a focus on exploitation, a structure that does not allow exploratory activities and a low amount of slack resources.

Several solutions are extracted from the two literature streams in order to tackle the obstacles to exploration. Regarding climate, these solutions incorporate an increase in risk orientation and the development of a shared vision regarding exploration which focuses on the R&D department. From such vision the R&D employees should really be able to derive what kind of activities is expected from them. Besides climate aspects, an idea management system for developing new technologies can help to stimulate exploration. Also a structure is needed which separates exploratory and exploitative activities and allocates resources to either exploration or exploitation.

The conclusions drawn from this research indicate that the organizational climate can affect the behaviors regarding exploration. Shared dimensions with exploration literature are risk, participative safety and achievement orientation. This thesis addresses that the climate does not influence exploration alone. Researchers should account for the interplay between the organizational climate and organizational structure when investigating exploration.

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1 Introduction

In this first chapter an introduction to the research is provided. After a short description of the company, the formulation of a research approach sets boundaries to the scope of this study. By denoting research objectives, research questions and a research strategy, the contents and the contribution of this research are clarified.

1.1 Company profile

Electro B.V. is a part of the Electrical division of Electro Corporation. Electro Corporation is a diversified power management company with sales of $11.9 billion in 2009. Electro is a global technology leader in electrical components and systems for power quality, distribution and control; hydraulics components, systems and services for industrial and mobile equipment; aerospace fuel, hydraulics and pneumatic systems for commercial and military use; and truck and automotive drivetrain and powertrain systems for performance, fuel economy and safety. Electro has approximately 70,000 employees and sells products to customers in more than 150 countries (Electro Corporation, 2010a).

Before the acquisition by Electro Corporation in 2003, Electro B.V. was a Dutch company named Electro Hengelo. The Electro Hengelo brand, at this moment under the legal entity name of Electro B.V. is part of Electro Corporation. Already for a century Electro B.V. develops, produces and sells products for switching, distributing and protecting electrical energy on low and medium voltage level. Under the brand name Electro Hengelo, Electro B.V. is a partner for utilities, electrical contractors and light and heavy industry (Electro Corporation, 2010b).

In Europe, Electro B.V. is part of the Electrical EMEA organization which has several non-technical divisions like Finance & Planning, Human Resources, Marketing, and Sales, but also technologically focused divisions like Industrial Controls Division (ICD), Industrial Automation, Power Distribution Components (PDC), and Electrical Solutions & Service (ESS). In Electro B.V. the technological departments ICD, PDC and ESS are represented, but due to reorganizations at European level the departmental structure is changing. In the last decades Electro Corporation has acquired a market share by incorporating several European companies. The last major acquisition in Europe was the takeover of Company M in 2008.

When Electro has acquired a company, the Electro Business System and corresponding processes are instituted. Within Electro B.V. the new product development tool ‘PROLaunch’ (Profitable Reliable On-time Launch) is applied. The PROLaunch tool consists of four layers: portfolio management, Six Sigma design and development, project management, and on top a phase-gate process. The phase-gate process, depicted in figure 1.1, is characteristic for PROLaunch and it is applied for all new R&D projects in Electro B.V.

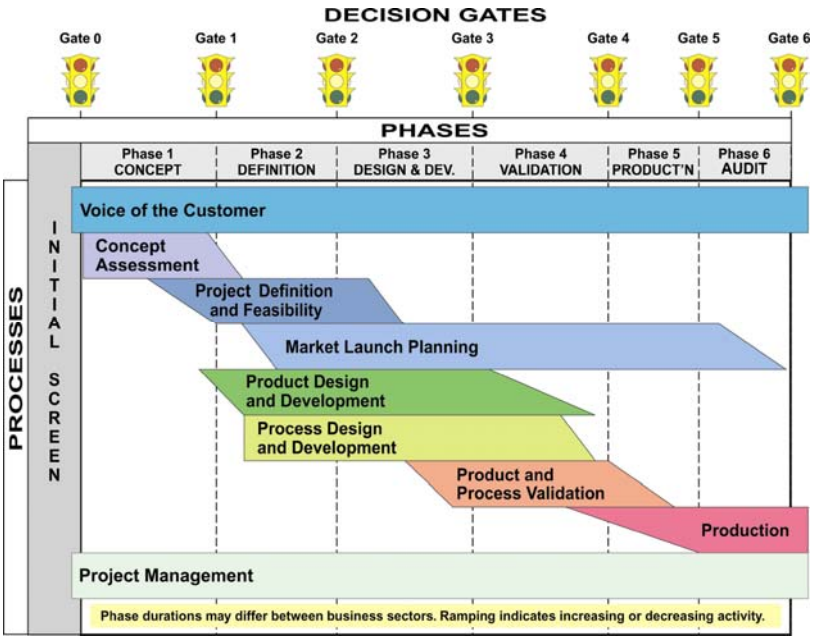

Figure 1.1 Representation of the phase-gate process of PROLaunch.

The worldwide Electro Corporation has created five Innovation Centers for servicing Electro's global business segments Electrical, Fluid Power, Truck and Automotive. They are located in Minneapolis, Detroit/Southfield, Milwaukee, Pune, and Pittsburgh. In the innovation centers a process tool called PreLaunch is used, see figure 1.2 for a graphical visualization. In theory, PreLaunch is executed in order to develop technologies and to justify commercialization. The last part of PreLaunch has an overlap with PROLaunch for starting product development and services in a thorough way. Within Electro B.V. PreLaunch is not used.

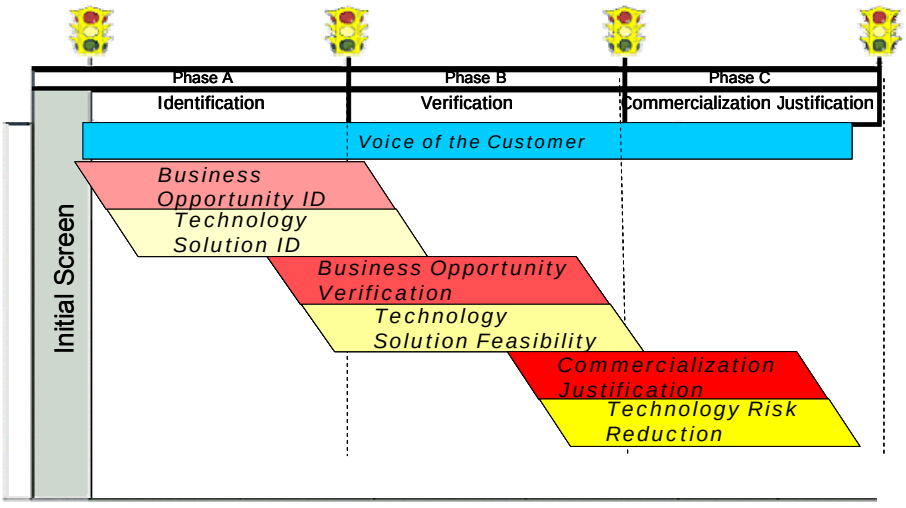

Figure 1.2 Representation of the phase process of PreLaunch.

1.2 Research approach

Innovation has become a popular term for a broad range of measures that should be taken in order to be a successful company. When investigating innovation and in particular innovation management,

one must focus on typical characteristics of innovation. In the field of technological innovation, which in short considers the development of new technical products and fabrication processes, a distinction is made between exploration and exploitation (March, 1991; Jansen, Van Den Bosch, & Volberda, 2006). Exploration considers activities that focus on developing fundamentally new products and technologies compared to previous products and technologies of a company. Exploitation is the improvement of existing products and technologies in a gradual way. Exploratory and exploitative activities result in different kinds of innovation, for example radical and incremental innovation, respectively.

The characteristics and the management of exploration and exploitation have extensively been investigated (Benner & Tushman, 2003; Jansen et al., 2006; Levinthal & March, 1993). Many studies focus on the organizational structure of a firm in order to find a structure that combines exploratory and exploitative innovation effectively. In 1976 Duncan was the first to denote this combination of extreme innovation types as organizational ambidexterity, proposing a 'dual structure' in order to achieve it. Examples of such structures are the distinction between mechanistic and organic structures (Burns & Stalker, 1961) and the ambidextrous organization (O'Reilly & Tushman, 2004). In the latter structure the company is divided into two parts of which one part focuses on exploratory innovation and the other part on exploitative innovation. The knowledge created in the separated parts is exchanged through a small top management team.

Still, innovation is not only the product of a well designed organizational structure. Besides having the right people on the right place, innovative activities must be executed in the organization (Vecchio, 1988). The results of innovation studies investigating structural aspects like size and decentralization have been inconclusive (Abbey & Dickson, 1983). According to Abbey and Dickson (1983), a possible reason for this finding is that these studies examine the whole organization as the unit of analysis, instead of the lower levels of the organization. Electro Corporation is a typical example of a large firm which' structure could be analyzed at a corporate level. At the level of Electro's subunits, like Electro B.V., it may not be enough to only focus on organizational structure since also other aspects may influence exploration and exploitation.

Internal social aspects may influence innovation activities as well (Subramaniam & Youndt, 2005). With social aspects of innovation one can think of the behaviors, attitudes and shared perceptions among employees. Social aspects in a company are often studied in the context of the organizational culture or climate (Ashkanasy, Wilderom, & Peterson, 2000). These contexts consider the company's managerial perspectives on social aspects, but also the perceptions and behaviors of lower level employees. The main difference between culture and climate is that studies on culture have a focus on the evolution of social systems, where climate studies look rather at the individual's perceptions within those systems (Denison, 1996). Considering the relational aspects of innovation, one of the goals of this thesis is to recommend improvements that can be applied directly at the individual level of the organization. Therefore, the climate context seems to be most appropriate for investigation.

A typical problem that Electro B.V. perceives regarding innovation is the execution of exploration. The organizational climate could contain obstacles to exploratory activities. As a result of that resistance, most activities in for example R&D divisions exhibit an exploitative nature. This research explores the mechanisms of organizational climate and organizational structure that are related to stimulating exploration. The goal of this research is to explore how the organizational climate and structure, separately or jointly, influence exploratory activities. To enhance the practical use of this thesis, the investigations aim at the R&D department of Electro B.V..

1.3 Academic research objective

This study investigates whether exploratory activities can be pursued by improving the social aspects of innovation, rather than only the firm's structure. Social aspects, in the form of the organizational

climate, are more complex and intangible than an organizational structure, but it may play a large role in how employees behave and influence decision making.

On the other hand, the organizational structure may influence the organizational climate. At the level a business unit, like Electro B.V., the addition of social aspects can be of significant importance in stimulation exploratory activities. This can be even more relevant for the relative small R&D department of Electro B.V., which contains about 50 employees compared to 950 employees of Electro B.V. in total. Social aspects at the R&D department may be of great importance when pursuing exploration. Thus, the scientific objective of this study is to contribute to the theoretical insights of the effect of the organizational climate and organizational structure at exploration. Regarding organizational structure, the focus lies on the structure of the R&D department.

1.4 Managerial research objective

According to a part of the management team of Electro B.V.'s R&D department the activities exploited within R&D are too much focused on internal projects that contribute only to existing products and technologies. The R&D management team acknowledges that this exploitative kind of innovation is not a long term approach in order to be sustainable. Electro B.V.'s R&D management team perceives that only the desire to focus more on exploratory innovation is not enough to actually engage in more exploratory activities. It seems that there is a resistance to such activities from employees that do not know how to combine the exploratory activities with the day to day work.

From this master's thesis Electro B.V. expects two things. The first objective is to find a solution to pursue more exploratory activities. This will be done by identifying the main obstacles to exploratory activities in the context of the organizational climate. Second, this thesis should come up with potential solutions to address these obstacles. If necessary, these solutions might affect the organizational structure in order to change the organizational climate. In this process a separation of the organizational climate for innovation at the managerial and engineering level will be included.

1.5 Research boundaries

Since this thesis is intended to be finished within a time span of six months, the scope of investigation must be quite narrow. By specifying the focus on the climate for innovation, the results of this thesis can be used for this specific aspect more easily.

One of the main focuses of this research is the management of exploratory activities. The level of analysis will be as low in the organizational hierarchy as possible. More specific, the analysis of the R&D department is pursued. Partly, the marketing department will be considered also since that department has a substantial influence on the new product development activities within R&D. With regard to the adaptation of innovation processes the focus lies on the social aspects of innovation. This includes the organization climate and the perceptions of innovation by employees.

1.6 Central question

The answer to the central question of this research should satisfy both the academic as the managerial research objectives. From an academic perspective the effects of the organizational climate on exploratory activities should be assessed since an increase and preservation of exploration is needed for executing both exploration and exploitation. From a managerial aspect the research should investigate the current company's situation. The research objectives have resulted in the following central question, which asks for a theoretical and practical analysis of the climate and exploratory activities.

What changes concerning the organizational climate should be made within the R&D department of Electro B.V. in order to execute more exploratory activities?

Definitions:

- *Exploratory activities*: Activities that "pursue new knowledge" and lead to innovation outputs which deviate from current technologies and/or from the existing market segment. (Levinthal & March, 1993, p. 105; Benner & Tushman; 2003)

- *Organizational climate*: "The shared perceptions of organizational members who are exposed to the same organizational structure." (Schneider, Brief, & Guzzo, 1990 in: Nystrom, Ramamurthy & Wilson, 2002, p. 222).

1.7 Research questions

The answer to the central question can be formulated by answering several research questions that lead to the central question. First, a clear insight must be acquired about the current state of the organizational climate for innovation at Electro B.V.'s R&D department. The analysis of the organizational climate will probably result in aspects that are considered constructive for exploratory activities and in aspects that caused resistance to it. It can be captured in the following question.

- What does the current organizational climate at Electro B.V.'s R&D department look like?

To link climate aspects to exploratory activities in the case of Electro B.V., also the state of and the experiences with exploratory activities within Electro B.V. must be examined. By acknowledging the points of resistance to exploratory activities, one step is made towards the improvement of radical innovation outputs. In these aspects of exploration, the structure of the R&D department can be assessed. The next research question occurs.

- What have been the obstacles to exploratory activities for the R&D department of Electro B.V. in the context of the organizational climate?

The final question for the preparation of an answer to the central question is to arrange possible and viable measures to solve the problems associated with exploratory activities. From a managerial perspective it is most interesting to have the problems with exploratory activities solved. Due to the organizational climate perspective of this study, the solutions will be framed along that perspective, which is interesting from an academic view. The associated research question is:

- How can the obstacles to exploratory activities be eliminated?

1.8 Research strategy

This research focuses on social aspects of innovation at the R&D department. Therefore, the data input for analysis consists of opinions and perceptions of R&D employees and some of their managers. Since in literature the role of climate on exploration is minimally investigated and since there was not yet specific information about the obstacles to exploratory innovation at the R&D department of Electro B.V., this study has an exploratory nature. The data was qualitatively collected by direct investigation of the people involved. For the data collection of this study the opportunity was created to gather data from multiple sources. These sources are an exploratory innovation scan at management level, a survey assessing the organizational climate at operational level, and two in-depth studies of innovation projects. The advantage of the use of multiple forms of data collection for qualitative research is that it increases the validity of the total study and it enhances the triangulation of the results. The research activities are described below. The detailed description of the methodology is provided in Chapter 3.

First, as a general exploration of innovation before the project studies, a survey research is conducted. An “Innovation scan” is developed at the University of Twente and it examines the state of innovation activities at a company. A modified version of that survey is used in this thesis and dimensions about the organizational climate are added. The preferred respondents of the survey are middle and high managers at the R&D and marketing department. At this state of development the survey allows a qualitative analysis of the state of innovation at Electro B.V.. The results are also used for internal evaluation and discussion at Electro B.V.. In addition, the climate dimensions have been evaluated at the operational level as well.

Second, a recently closed project was chosen and analyzed to evaluate Electro B.V.’s way of executing R&D. In order to reveal the current state of exploratory innovation at Electro B.V., the chosen project is a project which has the most exploratory character of the available projects for analysis. Regarding the research activities, first some exploratory interviews were taken to investigate the content and the goals of the selected project. Then, the documentation about the selected projects was investigated and semi-structured interviews with key employees regarding the project rendered specific information about the projects. Finally, the information from the documentation and the interviews enabled the identification of obstacles to exploratory innovation at Electro B.V..

Third, due to the lack of more suitable retrospective exploratory projects, the second project investigation studies the innovation activities by observing the activities of a project team during the start of a project. This typical form of field research can extract data about the present status of innovation activities at the R&D department. This method also allows for early involvement and adaptations regarding innovation practices, which is favorable for the actual implementation of the recommendations of this study. The analysis of a limited number of projects is in line with the qualitative nature of the research. By comparing this project with the innovation scan and the other project, a grounded assessment of the R&D department can be made.

Finally, based on literature and the results of the research activities, solutions can be formulated in order to tackle the obstacles to exploratory activities. By implementing the solutions, steps can be taken to develop Electro B.V. into a company that is more successful in exploration.

1.9 Outlook

This thesis continues with a discussion of relevant theoretical aspects in Chapter 2. Aspects of exploration, exploitation and ambidexterity are discussed, as well as the climate aspects of innovation. A detailed argumentation of the methodology is provided in Chapter 3. In that chapter the research design and the research activities are discussed. The results are presented in Chapter 4, giving an overview of the innovation scan and a description of the projects. The analysis of the results is reported in Chapter 5 in which the research questions are answered and where specific solutions for Electro B.V. are described. In Chapter 6 the conclusions and recommendations are formulated. The conclusions and recommendations have an academic nature since the practical recommendations are described in Chapter 5.

2 Theoretical Perspectives

The combination of exploration and exploitation is thoroughly investigated by multiple authors from different literature streams. The main literature stream on exploration discusses exploration in the context of organizational learning (March, 1991). Most studies focus on possibilities for firms to increase their exploration capabilities. Some studies describe the constraints that emanate from the conflicting demands when combining exploration and exploitation.

In section 2.2 an overview of the analyzed climate literature on innovation is provided. In literature on exploration and exploitation, little efforts are made in investigating the role of the organizational climate. Some scholars mention that a supportive culture and climate are necessary, but specific dimensions and corresponding best practices are scarce. Literature streams that explicitly investigate the role of organizational climate and culture in innovation theories often focus on innovativeness in general, in which occasionally a distinction between radical and incremental innovation is made. Often direct effects of the organizational climate on innovation are determined, but other scholars prefer to ascribe a moderating or mediating role to the organizational climate.

This chapter provides a general background in which the research is executed and it enables the comparison of the results to existing knowledge.

2.1 Exploration

In technological innovation, an often heard dilemma is the innovator's dilemma in which a choice must be made between developing radically new products and capturing the benefits of extensive developed products. Scholars from several literature streams like organizational learning, technological innovation, organizational adaptation, strategic management, and organizational design have described the combination of both extreme innovation types as an imperative for innovation performance (Adler, Goldoftas, & Levine, 1999; Benner & Tushman, 2003; Danneels, 2002; He & Wong, 2004; Levinthal & March, 1993; March 1991)

In 1991 March introduced the terms exploration and exploitation for the different innovation outputs, which have become generally accepted definitions. Exploration contains activities related to "search, variation, risk taking, experimentation, discovery and innovation". Although this thesis focuses on exploration, it is impossible to ignore its counterpart: exploitation. Exploitation regards contrasting activities like "refinement, production, efficiency, implementation and execution" (March, 1991, p. 71). The denominators exploration and exploitation have taken a flight from 1991, but the need to separate the distinct innovation activities was yet in 1976 expressed by Duncan as ambidexterity (Duncan, 1976). Here, a 'dual structure' is proposed in order to achieve separation of exploration and exploitation.

2.1.1 Challenges to exploration

In order to be sustainable on the long term, companies should both pursue exploration and exploitation, but combining exploration and exploitation comes with several challenges. A result of these challenges is often that there is a lack of exploration. The main challenges can be found in the company's habits, its structure, and its possibility of resource allocation. Also a firm's environment influences exploration. Table 2.1 provides on overview of the challenges related to exploration.

Competency trap

Levinthal and March (1993) discuss several threats that may shift the balance between exploration and exploitation. The 'failure trap' stimulates exploration due to the failures of previous innovations. A shift to exploitation can be caused by the competency trap, also known as the success trap. The success of exploitation in the past makes the use of the same technologies even more efficient in current practices. Also the feedback of exploitation is more direct and allows for fast adaptations for positive returns in the short term, making exploitation usually more attractive than exploration (Levinthal & March, 1993).

The competency trap is related to the myopia of learning: organizations usually do not look enough abroad when learning about new knowledge. Ahuja and Lampert (2001) ascribe it to a focus on familiar, mature, and adjacent technologies. The development of these kind of technologies does not require any exploratory activities. They thus result in exploitation.

Ahuja and Lampert (2001) propose to invest in novel, emerging, and pioneering technologies in order to overcome the familiarity, maturity and propinquity traps respectively. Novel technologies are existing technologies, but new to the firm. Emerging technologies are technologies which are not yet developed, which facilitates the discovery of multiple innovations. In pioneering technologies researchers behave like pioneers and they start developing technologies from the very beginning and in distinct directions compared to previous developments.

A possibility for creating a good balance, in case of low exploration and high exploitation, is a rapid upward adjustment of aspirations regarding exploration. According to Levinthal and March (1993), four solutions to the problem of sustaining exploration can be found in incentives, organizational structure, individual beliefs about risk taking, or internal selection processes.

First, incentives can be rewards for individuals that were successful in exploration, or these can be safety-nets for exploratory failures. In general, organizations seem to be most effective in the latter incentive measure.

Second, the organizational structure should be designed in such a way that excessive socialization of new members is avoided (Levinthal & March, 1993). New members are able to change the social code about 'how work is done'. But if the new members adapt too quickly to the code, the code can not be changed anymore towards a more exploratory kind.

Third, the willingness of individuals to take risks in pursuing exploration is affected by risk preference and perceived risk. Individuals that have not yet reached their target yet will increase risk taking, but those who are close to or above their aspiration level will prefer lower levels of risk. On the other hand, managers are able to influence the perceived risk. If the risk perceived is low, due to ignorance or misperception, individuals will be more confident in exploratory activities. The results can lead to failures for the individual, but in the long term the organization can profit from its incidental, but substantial successes.

Finally, the internal selection within organizations is not as much a solution to exploration but rather an explanation. Basically, Levinthal and March (1993) note that successful people are selected for promotions and unsuccessful people are removed. This leads to a situation in which most executives have mainly experiences with success and they thus have an illusion of control (Langer, 1975). These kinds of executives may be more willing to invest in exploration due to their confidence in a good outcome.

Size and structure

The competency trap is a trap that is developed over time. Another main challenge that firms can face in pursuing exploration in any point of time regards the firm size and structure. When a small or medium sized company becomes successful with a technological innovation, it is likely that the company grows in order to exploit that innovation. When growing, companies feel the need to

establish a structure which provides clarity and an overview of the company (Schoonhoven & Jelinek, 1990).

Two characteristics are typical for a growing company: the centralization of decision making and the increase of the formalization of procedures. Here, centralization is the extent to which decisions are made by a small number of managerial employees. Formalization is the extent to which rules and procedures are written down. None of these characteristics are beneficial for exploration: centralization of decision making is negatively related to exploration and formalization of rules and procedures is supportive for exploitation (Jansen et al., 2006). In combining exploration and exploitation, successful firms have made use of the interaction between decentralization and connectedness between subunits (Jansen et al., 2005).

The change to more centralization and formalization is observed when the structure of a company makes a transition from an organic to a mechanistic form (Burns & Stalker, 1961; Gibson & Birkinshaw, 2004). Organic structures have a low degree of formalization with much informal communication linkages, which is supportive for the generation of innovative ideas. The mechanistic approach uses more regulation and rules in doing tasks.

To solve the tensions between organic and mechanistic structures, quasi- or semi-structures can be applied in which the tension is dynamic due to frequent reorganizations and the application of transition processes (Brown & Eisenhardt, 1997; Schoonhoven & Jelinek, 1990).

Yukl (2008) determined four obstacles to collective learning which is important for exploitation, but even more for exploration. These obstacles can be linked to the organizational size and structure. They are a dependence on top management, restriction from information, subunit differentiation, and conflicts between stakeholders.

The first obstacle is a common belief that changes made in the organization are the responsibility of top management. A large number of hierarchical layers in a large company can create a gap between management and the operational personnel. This belief constrains initiatives of individual employees for proposing improvements to the organization. Bottom-up initiatives originating from a collaborative approach can be stimulated by systems and programs that support local initiatives.

Second, a restriction of information and knowledge from individuals can be a barrier for effective problem solving by other employees. Unequal distribution of information can lead to opportunistic behavior by employees who misuse the knowledge they have or employees may look for solutions that are already found elsewhere in the firm. A leadership solution lies in rewarding accurate communication, establishing a large access to information and the encouragement of social networks (Yukl, 2008).

Third, subunit differentiation may be a constraint to exploration since it improves efficiency, but it creates barriers to information sharing and cooperation as well. Within a growing business unit, differentiation can be found in the different functions of the departments. Cooperation and mutual trust can be improved by emphasizing shared values and objectives, but also by fostering appreciation for differences between units. Tangible rewards for inter-functional collaboration can stimulate information sharing among units.

The fourth obstacle Yukl (2008) determined for shifting the balance between exploration and exploitation is the conflict that is present between the various stakeholders in an organization. Disagreement between stakeholders opposes unanimous decision making regarding exploration, exploitation, or a mixture of them. Collective learning with the intent of long-term performance is best achieved when all stakeholders agree by means of a culture with shared values about learning. This can be supported by developing capabilities for knowledge acquisition, diffusion and application.

Slack resources

Devoting time to exploration is not only influenced by developed habits of a firm over time or its current structure. Also the extent to which companies are able to choose to spend resources on exploration or exploitation influences the amount of exploration within a company. Nohria and Gulati (1996) define

such resources as organizational slack: “the pool of resources in an organization that is in excess of the minimum necessary to produce a given level of organizational output” (Nohria & Gulati, 1996, p. 1246).

Lubatkin et al. (2006) found that firms with a wealthy resource base can afford to combine exploration and exploitation easier than firms short on slack resources. On the other hand, Levinthal and March (1993) consider that there is a balance between slack, search and aspirations. This means that in case of low slack, there will be more time spent on search, i.e. exploration. High slack leads to a risk aversion and thus a lower level of exploration. In addition, executing both exploration and exploitation shows to decrease an organization’s slack (Jansen et al., 2006). A threat of low slack resources regarding exploration is that firms are stimulated to pursue only a single form of innovation (Ebben & Johnson, 2005; Voss, Sirdeshmukh, & Voss, 2008).

Due to these contradicting findings, Nohria and Gulati (1996) suggest an inversed U-shaped relationship between slack and innovation, which means that a shortage, but also an abundance of slack resources is negatively related to innovation (Nohria & Gulati, 1996). Voss et al. (2008) make a distinction between absorbed and unabsorbed slack. Absorbed slack is slack which is already allocated, and unabsorbed slack is still free spendable.

Slack shows thus to be an important aspect to consider when assessing exploration. It can be beneficial, but also act as a constraint.

Environmental factors

A firm’s environment has shown to be an important factor for ambidextrous organizations. In a dynamic environment technologies change quickly, as well as customer preferences or product demands (Jansen et al., 2006). Environmental factors also include the rate of competitor activities. In stable environments these aspects do not change fast.

Environmental factors affect the relationship of ambidexterity on innovation outputs. Jansen et al. (2006) have shown that in dynamic environments the execution of exploratory activities is more effective than exploitation. In highly competitive environments, exploitation leads to a better financial performance. As a result it is not surprising the researchers have shown that for high dynamic and high competitive environments, organizations tend to become more and more ambidextrous (Levinthal & March, 1993; Jansen et al., 2005).

Considering the environment, low dynamism and a high level of competition may thus enhance exploitation and play a limiting factor for exploration.

2.1.2 Solutions

For stimulating exploration several solutions have been proposed. In these solutions also exploitation is discussed since exploration is closely linked with exploitation. Some authors think that exploration and exploitation can only be executed simultaneously when they are strictly separated. Others think that there are circumstances in which ambidexterity can be achieved without separation by creating the right organizational context (Adler et al., 1999; Benner & Tushman, 2003; Gibson & Birkinshaw, 2004; Jansen et al., 2006; O’Reilly & Tushman, 2004; Pandey & Sharma, 2009).

Raisch and Birkinshaw (2008) denote three forms of organizational ambidexterity: structural ambidexterity, contextual ambidexterity and leadership-based ambidexterity. These antecedents provide different settings for ambidexterity with typical characteristics promoting exploration or exploitation. Table 2.1 summarizes these mechanisms.

Table 2.1 Mechanisms for preserving exploration.

	Characteristics	Advantages (+) and disadvantages (–)
Structural ambidexterity	• Spatial separation • Parallel configuration (lateral relationships) • Temporal separation	+ Clear purpose of activities + Clear budgets – Integration efforts – Integration costs
Contextual ambidexterity	• Integration of exploration & exploitation • Uniform through whole business unit	+ Fast knowledge transfer + Less slack resources needed – Reduced task programmability – High responsibility for employee
Leadership-based ambidexterity	• Executives' goals for exploration or exploitation • Different focus for hierarchical levels • Influence on team composition	+ Adaptable to strategy – Low barrier to conflicts between executives – No direct effect on employee's tasks

Structural ambidexterity

The most straightforward form of ambidexterity is by physically separating exploration and exploitation. The big advantage is that both exploration and exploitation can be executed autonomously and that thus both competencies are maintained in the organization. Two general forms of separation are acknowledged: spatial separation and parallel structures (Raisch & Birkinshaw, 2008).

Spatial separation is usually applied at corporate or business unit level. Organizational units that pursue exploration are known to be small and decentralized with loose processes, while decision making in exploitative units is rather centralized and with tight procedures (Benner & Tushman, 2003). The main challenge remains to what extent the exploration and exploitation units should be integrated in order to leverage innovations resulting from exploration. Although still separated, some scholars suggest a loose coupling between units (Levinthal, 1997; Weich, 1976). Others demand a rigorous separation of both units in order to achieve disruptive innovations (Christensen, 1998). When the knowledge and capabilities of the two business units are loosely coupled by a top management team O'Reilly and Tushman (2004) speak of the ambidextrous organization. In addition, this top management team also needs to impose a strong, company wide culture.

In parallel configurations the knowledge exchange is achieved in rather lateral relationships between separate business units (Adler et al., 1999). An example of such lateral relationship is found in a production orientated setting. A temporary pilot team allows employees to switch between exploitative production activities and exploratory activities in the pilot team (Adler et al., 1999). Adler et al. (1999) use the term partitioning for the spatial separation of flexibility and efficiency. They see disadvantages in the extensive and expensive management efforts for the coordination of knowledge transfer, causing large overhead costs. Separation can also induce self-interested subunit behavior in which units compete for internal resources. In parallel configurations they are thought to be lower.

Sometimes companies apply exploration and exploitation periodically. In such temporal separation, whole business units switch between exploratory and exploitative tasks (Gibson & Birkinshaw, 2004). By doing this companies can respond to the dynamism and competitiveness of the environment. In a

stable and competitive environment, exploitation is pursued. In a high dynamic environment the focus may be put on exploration.

Contextual ambidexterity

Several authors have acknowledged that changing the organization's structure is not the only option for creating ambidexterity (Gibson & Birkinshaw, 2004; Jansen et al., 2006). Without changing the organizational structure, companies can create ambidexterity by influencing employees' behaviors. As Gibson and Birkinshaw (2004) suggest the solution lies in creating *contextual* ambidexterity. In this form of ambidexterity the organizational context is emphasized, which means that there is an "interplay of system capacities for alignment and adaptability that simultaneously permeate an entire business unit" (Gibson & Birkinshaw, 2004, p. 211). Changes of the activities can be executed in a fast and structured way through the whole business unit. The combination of exploration and exploitation within a business unit enables fast knowledge transfer and needs less resources for integration purposes. In contextual ambidexterity the individual employee of the company is able to make their own judgments and divide the time that should be spent on exploration and exploitation.

The actual execution of both exploration and exploitation in one context can be stimulated by mechanisms like meta-routines and job enrichment, developed in earlier studies (Adler et al., 1999).

Meta-routines are exploratory non-routine activities that are transformed into more-routine activities (Adler et al., 1999). It structures innovative activities, but they are not entangled with efficiency promoting routine activities. Downsides of meta-routines are goal displacement in which the conformation to the routines is the new goal instead of the non-routine tasks. It may also entail reduced task autonomy.

Job enrichment may contribute to ambidexterity since one job can have different aspects. Disadvantages of job enrichment are the involved cost due to training, a reduced programmability of the employees' tasks and the hazard of job enlargement which may result from job enrichment.

Measures that account for the disadvantages of contextual ambidexterity are provided by Adler et al. (1999) in establishing a culture that stimulates the individual employee to initiate improvements, investments to support those initiatives, rewards for innovation and a strong leadership style that shapes the culture. In addition to Ghoshal and Bartlett (1994), Gibson and Birkinshaw (2004) argue that a balance between a pair of hard elements, discipline and stretch, and a pair of soft element, support and trust, can create a supportive organization context for ambidexterity.

Leadership-based ambidexterity

In structural and contextual ambidexterity, leadership plays a large role. For example, in structural ambidexterity O'Reilly and Tushman (2004) ascribe important tasks of coupling ambidextrous business units to senior executives. The loose coupling in parallel structures asks for accurate managerial skills for knowledge exchange. In contextual ambidexterity leaders are responsible for an effective implementation of the right mechanisms and behavioral attitudes.

Other scholars regard leadership as an independent antecedent of ambidexterity (Lubatkin et al., 2006). Mom et al. (2007) showed that firm-level outputs may be exploratory or exploitative depending on the exploration or exploitation activities of their managers. In other cases executives may find themselves focused on either exploration or exploitation as an expression of strategy, depending on their hierarchical level (Floyd & Lane, 2000). Ambidexterity is created when lower level managers focus on exploration and top management guards the exploitative outputs of the firm by selecting a limited number of exploratory innovations.

A setback may be that the competing goals of the managers can induce conflicts between executives. Also, this kind of ambidexterity may only be an indirect way of changing employee's tasks.

Others find a leadership role in establishing team composition. Ambidexterity can be promoted by having team members with common and diverse affiliations with prior company experiences (Beckman, 2006). An example is a team constitution of both “newcomers” and “old timers” (Perretti & Negro, 2006).

Leadership style also influences ambidexterity. Transformational leadership is a leadership style that increases the effectiveness of senior team attributes, like a shared vision and contingency rewards, in ambidextrous organizations (Jansen, George, Van Den Bosch, & Volberda, 2008).

2.2 Organizational climate

Many authors on the subject of the social organizational context acknowledge that studying these areas is not very straightforward. Mostly the organizational culture and organizational climate are used as theoretical constructs. Due to the difficulty to grasp the contents of culture and climate, a clear consensus about definitions and the critical dimensions has not been reached yet.

In this section, first a clarification about the difference between culture and climate research is provided, showing that studies on culture and climate can not be separated easily nowadays (Denison, 1996). Then, the emphasis is put at topics that are used in innovation studies that consider the organizational climate. At that point the choice is made to describe the climate for innovation in two ways: one at the general level of a business unit in analogy to Nystrom (2002) and another at the level of a work group, as developed by West (1990).

2.2.1 Culture or climate

When behavioral and relational aspects within an organization are measured, the organizational culture and climate are important to consider. But when is an activity a part of a culture or when are perceptions of employees elements of a climate, or can they be a part of both? Denison (1996) has dedicated a study to the evolution of culture and climate and their entanglement in order to predict how both contexts can be used in the future. To place both contexts in a historic perspective, the first social organizational studies consider the climate of an organization.

The investigation of the organizational climate was initiated before 1950 when Lewin and others tried to capture subjective elements of an organization in an objective way (Lewin, 1951; Lewin, Lippit, & White, 1939). In 1968 Litwin and Stringer had developed several climate dimensions like structure, responsibility, reward, risk, warmth, support, standards, conflict, and identity (Litwin & Stringer, 1968). In the last decades several dimensions have been added and developed, but in the mid-1980s researchers of social aspects of the organization started to use culture as a denominator (Denison, 1996). Denison notes that the difference of the culture research with climate research lies in the methodology. Climate researchers were used to applying quantitative research methods, but in the field of culture research qualitative methods were preferred in order to capture the unique aspects of individual social settings (Denison, 1996). When Denison observed that from 1990 also studies on culture started to use quantitative methods, the need for clarification was created.

Besides differences of methodological aspects also the level of analysis, temporal orientation and scientific disciplines of cultural and climate were known to be different in the past. For example, the level of analysis of organizational culture investigation has a tradition of looking at underlying values and assumptions of a cultural system instead of the organizational climate, in which surface-level manifestations and readily to observe practices are examined (Denison, 1996). This resulted in a difference of temporal orientation because culture research tries to capture the organization’s values by investigating its development over an extended time-span, but climate attributes can be measured in a short time, resulting in a snapshot of climate conditions. With regard to scientific disciplines, culture literature has roots in sociology and anthropology, and climate literature has extended theory of psychology since its initial focus was on the individual’s perceptions. Over time this focus has shifted

to the perceptual measurement of organizational attributes and eventually to a combination of perceptual and more objective measurements (Denison, 1996).

Definitions

In separating culture and climate, two definitions have evolved. A common description of culture is “the deep structure of organizations, which is rooted in the values, beliefs, and assumptions held by organizational members” (Denison, 1996, p. 624). The more superficial approach of the organizational climate considers “organizational environments as being rooted in the organization's value system, but tends to present these social environments in relatively static terms, describing them in terms of a fixed (and broadly applicable) set of dimensions” (Denison, 1996, p. 624). In other words, the organizational climate describes manifestations which can directly be observed in an organization and the determination of culture needs a more longitudinal and in-depth analysis.

Common dimensions

The use of the two definitions suggests that culture and climate studies can be separated easily, but the emergence of quantitative culture studies and qualitative climate research threatens the distinction. Not only the research methods are interchanged, but more important, also the dimensions and organizational attributes, which are measured, are used in both contexts. Denison (1996) lists three authors on culture and three authors on climate that use comparable dimensions for the assessment of their context. These dimensions are *structure, support, risk, cohesiveness* and *outcome orientation*. Examples of cohesiveness are the rate of team work and collectivism. Also the items in the culture and climate scales show clear similarities (Gordon & Christensen, 1993).

In organizational change literature, Schneider et al. (1996) have proposed that the organizational culture can be changed through a focus on the climate. Since the climate is expressed in surface manifestations like everyday policies, routines and procedures, a change of the climate will eventually lead to a change of the culture. According to Schneider et al. (1996) the climate can be identified by four dimensions.

First, the *nature of interpersonal relationships* is a part of the climate. The relationships can have a nature of high trust or mistrust. They also consist of different forms of inter-functional relationship between departments, which can be competitive or cooperative.

Second, decision making processes can be assessed with the *nature of hierarchy.* Involvement and the strict separation of hierarchical levels determine this nature, but also the approach from executives towards employees can differ in nature in an individual approach or a focus on project teams.

The third aspect is the *nature of work.* Whether jobs are challenging or boring affects the organizational climate. The ability to adapt the execution of the work, or the restriction from it influences the perception of how the remaining daily activities should be done.

Fourth is the *focus of support and rewards*. This goal oriented dimension considers the actual criteria for approving rewards or denoting support. These criteria can be stipulated on speed and quantity, or carefulness and quality. The goals and standards to which new employees are trained is also an expression of aspects which are supported in the organization (Schneider et al., 1996).

The dimensions of climate determined by Denison (1996) and Schneider et al. (1996) show several similarities. The *nature of interpersonal relationships* can be regarded similar to Denison’s *cohesiveness*. The *nature of hierarchy* by Schneider et al. (1996) resembles the *structure* dimension, where the *focus of support and rewards* is analogous to the *support* and *outcome orientation* of Denison.

In order to conclude on the difference between culture and climate Denison (1996) argues that climate and culture are different interpretations of the same phenomenon. By acknowledging this, the path is free for combining quantitative and qualitative research methods. No more researchers should be

constrained by a research tradition matching their interpretation. In studying organizational contexts the traditions of culture research and climate research could be incorporated in order to obtain more standardization in this field of research (Denison, 1996).

2.2.2 Climate and innovation

Studies on the organizational climate typically determine what the effects are when a climate changes or what properties of the climate are causes for typical outcomes. A tendency in climate literature is that authors tend to use a facet-specific approach of the climate, rather than observing the climate and its outcomes in general (Anderson & West, 1998; Schneider, 1990). Sometimes, a general perspective is still favored since it can render an overall picture of how organizations operate as a whole, but when a typical dimension of the climate is investigated, the traditional measures of the general perspective appear to be not focused enough (Ashkanasy et al., 2000, Patterson et al., 2005). Several examples of facet-specific dimensions of climate are a climate for quality, service, change, safety, and innovation (Anderson & West, 1998; Schneider, 1990).

Some studies have investigated the effects of climate variables on innovation outcomes (Abbey & Dickson, 1983; Ahmed, 1998; Anderson & West, 1998; Harborne & Johne, 2003; Sarros, Cooper & Santona, 2008; Scott & Bruce, 1994). The theories of those studies only look at the climate factors. A distinction is made between the climate at firm level and at group level.

Others ascribe a moderating role of climate. Such relationships are investigated since researchers have been looking for other variables that were not controlled in earlier studies (Nystrom et al., 2002; Sethi & Sethi, 2009). Moderators affect the relationship which they moderate at the same time as the initial relationship is observed.

When a construct is said to be a mediating variable, the causal relationships are rather sequential in time. Not climate, but culture is often found to be a mediator between antecedents and innovation (Ekvall, 1996; Lin & McDonough, 2009; McLaughlin, Bessant & Smart, 2005; Panuwatwanich, Stewart & Mohamed, 2008; Sarros et al., 2008; Scott & Bruce, 1994).

The different relationships indicate that the role of climate in innovation literature is still a point of discussion. Although theory development is not the goal of this thesis, the outcomes of the research can contribute to qualitative insights about the most suitable relationship. Figure 2.2 depicts three relationships that are described in literature and on which will be reflected at the end of this report. The three main variables are organizational structure, organizational climate and exploration.

This chapter continues with the formulation of a climate for innovation, which provides a frame of reference for the ‘Analysis’ chapter. A distinction is made between climate dimensions at a general managerial level of the organization and at group level.

General climate for innovation

When researchers try to describe the direct effects of the climate on innovation, the result is often a composition of dimensions with positive or negative relations to innovation. In 1983 Abbey and Dickson have investigated the direct effects of work climate in semiconductor R&D subsystems. They perceived the need to increase the number of dimensions of the relation of work climate to innovation, but out of ten dimensions only two proved to be reliable. Still, these two dimensions, rewarding performance and the willingness to experiment and try new ideas, are recurring dimensions in later studies on a climate for innovation (Anderson & West, 1998; Ghoshal & Bartlett, 1994; Scott & Bruce, 1994).

Rewarding performance and willingness to experiment can also be found in the climate dimensions used by Nystrom et al. (2002). They have developed a model, depicted in figure 2.3, in which the organizational climate moderates the relationship between the organizational context and organizational innovativeness.

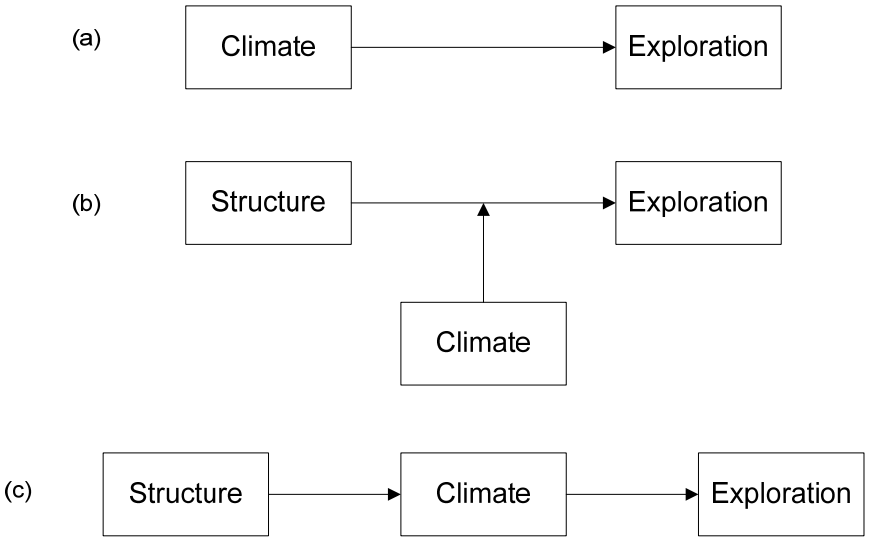

Figure 2.2 Visualized examples of possible theoretical relationships between organizational climate, structure and exploration: (a) a direct relationship, (b) a moderating relationship, and (c) a mediating relationship.

In their search for mechanisms that influence a firm's performance, the adoption of technological innovations is studied. Nystrom et al. (2002) acknowledge that the literature on innovation is focused on structural and contextual elements. In this study, the organizational context is not defined like Ghoshal and Bartlett (1994) do for contextual ambidexterity, but the organizational context is expressed in the variables *organizational size, slack resources* and *organizational age*. This means that the organizational climate is separated from the organizational context.

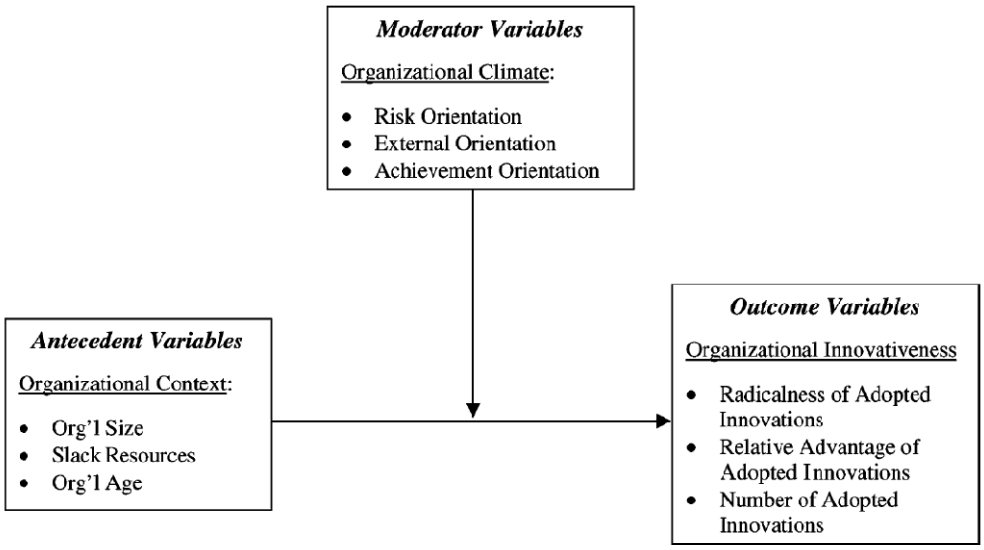

Figure 2.3 Organizational climate as a moderator of the context-innovativeness relationship. From "Organizational context, climate and innovativeness: adoption of imaging technology", by P.C. Nystrom, K. Ramamurthy, and A.L. Wilson, 2002, *J. Engineering and Technology Management*, 19, p. 223.

The three dimensions used by Nystrom et al. (2002) to measure the organizational climate that affects the adoption of innovation are:

- Risk orientation
- External orientation
- Achievement orientation

First, risk orientation is related to the adoption of radical innovations since in an organization that has a high risk taking climate, the adoption of radical innovations is known to be high. Risk orientation can be seen as an attitude which is not conservative and in which the development of radical new techniques is stimulated. The explicit encouragement to take risks is related positive to product novelty, an indicator of exploration, but on the other hand, a risk taking mentality may lower the new product's appropriateness (Sethi & Sethi, 2009).

Also culture studies have appointed risk orientation as a dimension of culture. When a culture is not managed, the culture tends to evolve into a culture which supports low risk incremental innovation (Dougherty & Heller, 1994). In McLaughlin et al.'s (2005) case study in an R&D setting of a small to medium sized companies they determine nine emerging themes of organizational culture, but which show similarities to climate as well. The themes are risk, resources, external trust, clear objectives, team constitution, external perspectives, freedom, internal trust, and department growth. The contents of the themes shapes the culture towards supportive for either radical or incremental innovation. For example, radical innovation is promoted with a culture with high freedom, encouragement of risk taking, a "do different" external perspective, and moderately specified objectives (McLaughlin et al., 2005).

Second, the external orientation regarding innovation adoption is the power of employees to perceive the needs of the customer. Previously, external, but also internal, communications have been acknowledged as positive for innovation (Damanpour, 1991). If there is a climate that stimulates the awareness of the customer's needs by means of these communications, the adopted innovations will be more suitable for solving the problems of customers.

In an external orientation the knowledge about customers is not the only aspect. Narver and Slater (1990) have validated a 'market orientation' measure in which a competitor orientation and an inter-functional coordination are added to the customer orientation. These measures are also applied by Nystrom et al. (2002) for determining the external orientation.

The third dimension, the achievement orientation, reflects the desire to realize goals and the willingness to meet a certain level of quality. Opposed to an achievement orientation is the orientation to strictly follow rules and procedures, which can be seen as the execution of a high degree of formalization. Firms with a high achievement orientation will have less rules and procedures, but rather create other possibilities in achieving goals. Nystrom et al. (2002) link achievement orientated firms to firms which have organic structures which are positively related to innovation.

The main findings of Nystrom et al.'s (2002) study is that organizational size and organizational slack have a direct positive effect on innovativeness, but regarding organizational slack, none of the climate variables moderated this relationship. This is ascribed to a missing distinction between "absorbed" and "unabsorbed" slack. The study shows that a high risk orientation increases the positive relationship between organizational size and innovativeness. The external orientation moderates the positive relation between organizational age and innovativeness such that organizational innovativeness is higher for a high external orientation. A surprising result of the study is the diminishing effect of external orientation on the positive relationship between organizational size and innovativeness. It is explained with the suggestion that large firm's are more selective in adopting new innovations than small firms.

Group climate for innovation

The climate for innovation can also be assessed on the level of the project group. West (1990) has developed dimensions of the climate for innovation with respect to work groups. He encounters that in most studies of climate the unit of analysis is the whole organization, but also that there are concerns about whether one organization can be described by only one climate. Since organizations exist of different departments, roles and hierarchical levels, one organization could comprise multiple sub-climates (Anderson & West, 1998). In his view, innovations are a product of relative small groups of employees who collaborate intensively. Therefore, he has developed a theoretical four-factor model for determining the climate for innovation of small work groups. By focusing on a specific aspect of climate and related group outcomes, Anderson and West (1998) try to achieve a greater predictive accuracy than models that focus on the whole organizational climate. Other studies have constructed and validated explicit measures for assessing the dimensions of the model (Agrell & Gustafson 1994; Anderson & West, 1998).

West's (1990) four-factor theory of climate for innovation contains the following dimensions:

- Vision
- Participative safety
- Task orientation
- Support for innovation

Vision includes components that resemble the goal setting, which results in a certain level of motivation of the work team. The dimensions of vision are clarity, visionary nature, attainability and sharedness. Here, clarity is the extent to which the goals are understandable. The visionary nature is the extent to which the outcomes of the goals are useful for the individuals in the group. Attainability refers to the degree to which the vision is achievable. Visions that are not attainable have shown to be demotivating or so abstract that practical achievement is not likely (Anderson & West, 1998). The degree to which the vision is uniform within the team is determined by sharedness.

Sarros et al. (2008) show that a transformational leader who *articulates vision* positively influences the climate for organizational innovation. Tangible actions of visionary leaders are providing resources, personnel, and rewards to innovation, but also free spendable time for employees to pursue creative ideas (Sarros et al., 2008).

Participative safety concerns the degree to which group members are free to act and whether they will be punished for mistakes. Best is an interpersonal atmosphere of trust and support, because in such environment people are more willing to show initiative and propose new ideas (Anderson & West, 1998). The involvement in decision making contributes in a large extent to the perception of participative safety. This involvement can be enhanced by having influence on decisions, interacting and sharing information.

Other scholars have used dimensions similar to participative safety. Examples are the exent to which autonomy or empowerment are present in a company. In a study on alternatives to structural ambidexterity, Sethi and Sethi (2009) suggest a moderating effect of autonomy. Autonomy is defined as the freedom to make project-related decisions without interference from senior executives. Autonomy did positively influence the positive effect of encouragement to take risk on product novelty. Ahmed (1998) has shown that when the climate conditions for innovation conditions are met, empowerment is effectively established within teams.

The third factor of West's model, task orientation, evaluates the willingness of a group to improve the task performance. For this purpose several mechanisms can be used like evaluation and adaptation tools for increasing performance, feedback, clear outcome criteria, investigation of contradicting opinions and performance appraisal (Anderson & West, 1998). Task orientation allows for clear accountability measures at the individual and team level.

The commitment to excel in task performance through a task orientation shows similarities to Nystrom et al.'s (2002) achievement orientation. From a managerial level a task or achievement orientation is communicated to organizational employees. The extent to which such orientation is received, influences the task orientation at operational level.

Finally, support for innovation can be expressed in two ways: articulated and enacted. Articulated support is uttered through official documents like personnel documents, policy statements, or oral statements made by leaders. Enacted support is the support that physically enables innovation practices. In developing innovations, support can be enacted by providing resources to innovation teams (Daft, 1986).

Scott and Bruce (1994) have investigated the effects of leadership, work groups, and individual attributes on innovative behavior. The climate is constructed of the dimensions *support for innovation* and *resource supply*. They can be seen as articulated and enacted support, respectively. The study shows a significant positive relationship of support for innovation on innovative behavior.

Rewarding innovation and innovation activities is a shared expression of providing support (Abbey & Dickson, 1983; Ahmed, 1998; Sarros et al., 2008)

In R&D organizations Bain, Mann and Pirola-Merlo (2001) have investigated the importance of the four factors. For R&D teams the aspect of Participative Safety is less crucial compared to other kinds of teams. When dividing R&D teams into research or development teams they found that for research teams Support for Innovation and Task Orientation are most important in achieving a high innovative performance.

2.3 Summary

This chapter indicates the main challenges that firms face when stimulation of exploration is aspired. One cause of low exploration is the tendency to focus on activities that further develop existing technologies and products. In the short term such activities are attractive since they lead to more profit than exploratory activities. The organization's size and structure could limit exploration too. Growing organizations tend to become mechanistic through which they become less responsive to new developments. Exploration is also a matter of investing into the future. When companies can not afford to do so due to a lack of organizational slack, exploration could be limited. Finally, the organization's environment influences whether exploration or exploitation is most effective to execute.

Opportunities for stimulation exploration are found in several forms of separating exploration and exploitation. This separation can be achieved in ambidextrous structures with spatial or temporal separation. Other possibilities do not focus on the structural aspects, but they rather define the contents of the work and the context in which the work is done. The organizational climate is linked to the organizational context, but its content is not thoroughly developed in exploration literature.

The literature that does focus on climate and innovation can be reduced to climate dimensions that describe the climate within an organization or within a group and individual level. At the organizational level the most profound concepts are a risk orientation, external orientation and achievement orientation (Nystrom et al., 2002). At group level concepts like vision, participative safety, task orientation and support for innovation are characteristic for determining the climate (West, 1990).

The climate elements as described in this chapter will be used to evaluate the climate at the R&D department of Electro B.V. Then challenges for exploration at Electro B.V. are determined, relying on challenges from exploration literature and on climate literature on innovation. The knowledge about the resistance to exploration at Electro B.V. enables the formulation of solutions that fit to the company.

3 Methodology

This chapter states which methodology is chosen and why. First, some general remarks about the research design are presented, accompanied with the justification of its use in this research. Second, the specific activities used for data collection are discussed.

3.1 Research design

The first choice that must be made when starting social research is about the type of research. A general distinction is made between qualitative and quantitative research. Both types have advantages and disadvantages, but also the research objectives play a role in the determination of the preferred research type. In this thesis the research is exploratory and intends to determine obstacles to innovation. The research angle of the organizational climate promotes a research at an individual level to best capture the employee's perceptions. For these purposes a case research design shows to be most suitable.

One of the most profound advantages of case study research is that it permits the investigation of research subjects in their natural environment, so without creating an artificial setting for research. Also, the problems and concepts analyzed can be more complex when using qualitative research instead of only quantitative research. A third advantage is that qualitative research allows the input of new problems, topics and solutions in contrast to the rigid frame of analysis of quantitative studies. Other key words that are mentioned in favor of qualitative field research are the depth of understanding, its flexibility and the relative low costs that come with the research.

Support for the choice of a case study design is extracted from the fact that this research is conducted within a single company. Using the case study design, complex, firm specific aspects of innovation can be investigated directly at employee level. Therefore, this study will have a high internal validity since the arguments made at the end of this thesis follow directly from the investigations. The risk of a low reliability can be reduced by some operationalization metrics, like comparative evaluations. This is important for the academic value of this thesis, but from managerial perspective the reliability is not as important as the validity. Eisenhardt (1989) specifies that "case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations." (Eisenhardt, 1989, p. 534). In this thesis the opportunity for a wide range of data collection methods and the embedded nature of the research at Electro B.V. support the choice of the case study design.

The execution of case research is described extensively in handbooks and literature about methodology (Benbasat, Goldstein & Mead, 1987; Eisenhardt, 1989; Yin, 1984). Case studies can be done on single or multiple cases. Single case studies can be used for the exploration of undiscovered research fields and multiple case studies are useful for description or theory building and theory testing (Yin, 1984). The exploratory investigation of the relationships between exploration and the organization climate supports the choice for a single case study. In this thesis Electro B.V. will be the subject of the case study with a focus on the R&D department.

3.2 Research activities

Several scholars advocate the combination of qualitative and quantitative methods for social research, especially within case studies (Gable, 1994; Kaplan & Duchon, 1988). The advantages of both types can be captured and the disadvantages can be compensated. The use of several research methods enhances the triangulation of findings within a study, increasing its scientific value. A survey research is conducted to explore the current state regarding innovation and the organizational climate at Electro

B.V.. For the in-depth research activities in this thesis, two projects are chosen to frame the qualitative research activities like observations and interviews. Through the project analyses the climate can be determined. Figure 3.1 shows how the research activities are related.

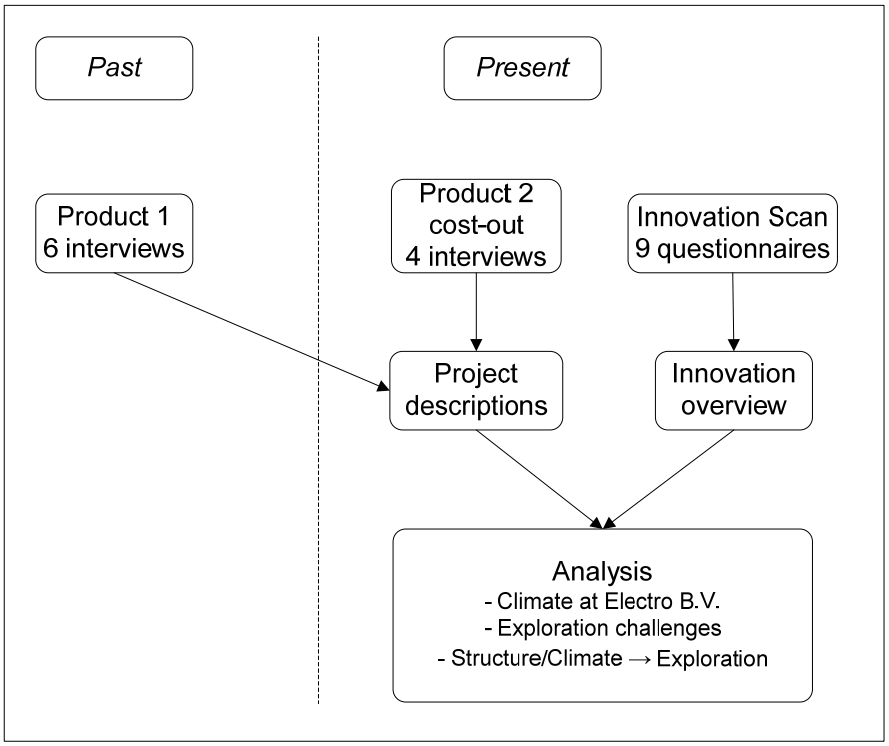

Figure 3.1 Visualization of the research activities. The 'Results' are formed by the 'Project descriptions' and the 'Innovation overview'.

3.2.1 Innovation scan

A sample of 9 employees is selected for the survey. It is a combination of employees in the management of the R&D department, the marketing department, and the human resources department. By investigating that sample of respondents, the results of the questionnaire will enable to draw conclusions about the management's view on innovation. Scholars argue that the values and believes of a company contribute to the organizational climate (Denison, 1996). Since management determines the strategy for innovation, it will also reflect their values and believes and thus the climate regarding innovation. The findings about the climate for innovation, originating from management perspective will be compared with findings about climate at engineering level.

Measures and scales

The actual survey is an adapted part of a self-assessment questionnaire, developed at the University of Twente, which is a tool for making an 'innovation scan' of a company. The constructs of the innovation scan can be used to make a rough estimation whether the management's view on innovation supports exploration or exploitation. The used scales and the corresponding items are stated in Appendix A.

The innovation scan is used to provide support for a conceptual model considering competencies for innovation. These competences consist of the Organization of Innovation, Human Resource Management and External Orientation. In the model, depicted in figure 3.2, the three competencies

influence the Innovation Performance, which is a concept for the success of the innovation process. The elements of the model are assessed with survey questions about employee's perceptions and firm specific facts. Next to the model of competencies for innovation also constructs about the organizational climate are used for the application in the thesis.

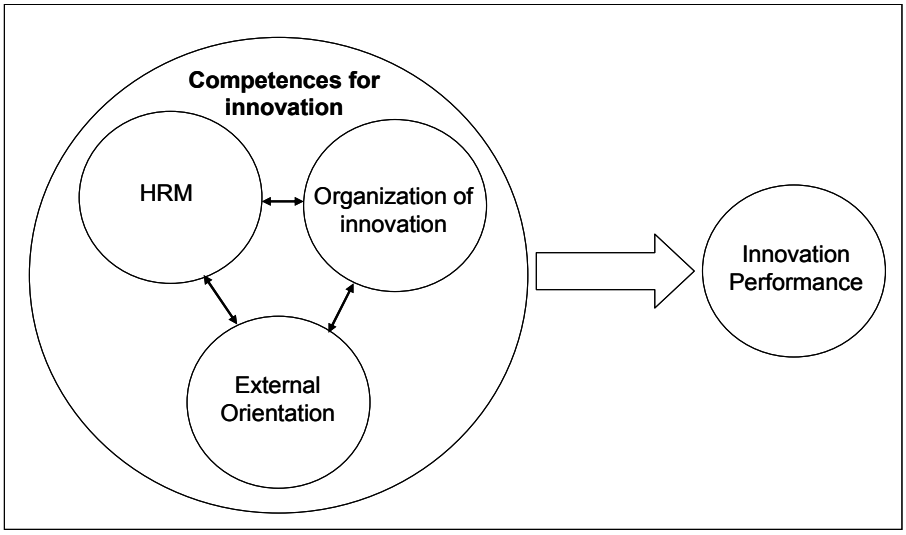

Figure 3.2 The model of 'Competences for innovation' for which in the innovation scan was developed.

The Innovation Performance is conceptualized by the *entrepreneurial orientation* and the *success of innovations*. Dimensions of *entrepreneurial orientation* are pro-activeness, innovativeness, risk-taking and competitive aggressiveness as described by Lumpkin and Dess (2001). In that study the dimensions are used to determine the entrepreneurial orientation, which shows resemblances with the strategic orientation of a large firm towards innovation. The measures of the *innovation success* have been developed for the innovation scan. The items consider product development time, new product quality and budget/time performance.

The Organization of Innovation contains the concepts *environment, exploration and exploitation*, and the *innovation process* described by Tidd et al. (2005).

Regarding the *environment* its *instability* is measured with a construct used by Bantel (1998), based on measures developed by Khandwalla (1977). A second construct of the environment is *differentiation*, developed for this survey and considers differences between products and production and sale methods.

Also perspectives about *exploration* and *exploitation* are measured to capture the organization of innovation. It is important to note that exploration and exploitation resemble the thoughts about innovation better than radical or incremental innovation since they result directly from strategy as *ex-ante* objectives (He & Wong, 2004). Still, the exploration and exploitation scales used by He and Wong (2004) are rather focused on outputs than on activities.

The *innovation process* by Tidd et al. (2005) contains four phases: *search, selection, implementation and learning*. Figure 3.3 graphically presents the innovation process. The *search* phase is mainly focused on detecting signals regarding possible innovations. Tidd et al. (2005) warn that firms have the tendency to develop too specific search patterns, which can be a barrier for discovering radical ideas. The second phase, *selection*, knows three inputs that influence the eventual selection of ideas: the flow of ideas and opportunities, the current technological base of a firm and the match of the innovation strategy with the overall business strategy. In the *implementation* phase, the right pieces of knowledge are put together by: acquiring of knowledge resources, executing the project, and launching the innovation. The fourth phase of Tidd's et al. (2005) process is the *learning* and re-innovation phase. In this phase not only the innovation is evaluated, but also the process in the

organization is assessed. The last, *learning*, phase is most important when the innovation process is repeated.

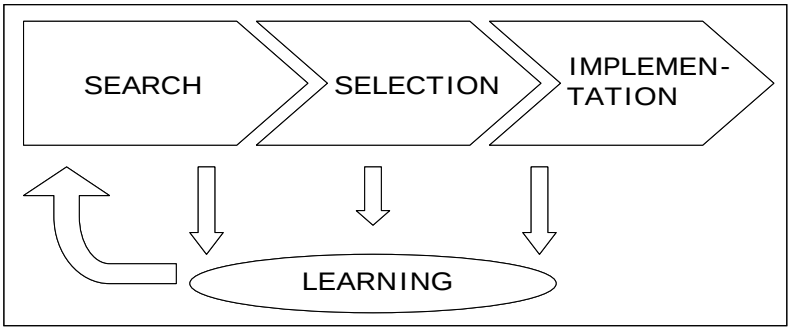

Figure 3.3 A visualization of the innovation process by Tidd et al. (2005).

The Human Resource Management dimensions are *human capital*, *innovation oriented Human Resource (HR) policies* and *knowledge management*. These dimensions are measured by single constructs. Human capital measures the level of knowledge, skills and attitudes of the firm's employees. The HR policies oriented on innovation concept measures the extent of applied policies specified for operational, supportive and managerial personnel.

The External Orientation is represented by the *market orientation*, *embedded ties* with suppliers and customers and *learning* from external parties. Regarding market orientation, constructs developed by Narver and Slater (1990) are used considering *customer orientation, competitor orientation* and *inter-functional coordination*. Ties with suppliers and customers are determined with constructs about *joint problem solving, information sharing* and *trust* (McEvily & Marcus, 2005). McEvily and Marcus also used a construct named *vicarious learning* as a control variable in their study. Here it is used to determine the willingness to compare and adjust Electro B.V. to competitors.

Climate measures

Four dimensions are added for the determination of the organizational climate. These address *risk orientation, external orientation, achievement orientation* and *empowerment*. The first three dimensions are the dimensions used by Nystrom et al. (2002) for assessing the climate. The empowerment climate was developed by Wilderom et al. (2009). The dimensions of West's (1990) group climate are not measured since initially the innovation scan was only taken from the managerial personnel. For comparison purposes the same dimensions were later measured at the operational level.

First, the dimension *risk orientation* is based on a scale of Litwin and Stringer (1968), also applied by other scholars for the measurement of organizational climate. This is the second 'risk' dimension used in this thesis. In the innovation scan it is named *risk-taking*. Here, *risk orientation* is used as climate dimension.

Second, the external orientation concept used by Nystrom et al. (2002) for the construct of climate, consists of several scales developed by Narver & Slater (1990), which were already a part of the original innovation scan. It contains the scales about customer orientation, competitor orientation, and inter-functional orientation, which in the innovation scan are ranged under *market orientation*.

The third dimension, achievement orientation, is extracted from the ten dimensions of the Organizational Climate Index (OCI) by Stern (1967). This two item scale determines the organization's concern for excelling. In order to limit the number of items the OCI is not used in total. The achievement orientation is chosen since it is a part climate measure by Nystrom et al. (2002).

The fourth and final dimension of the organizational climate is empowerment, developed by Wilderom et al. (2009). The empowerment dimension is chosen for its similarities to the 'involvement' dimension of West's aspect of Participative Safety. The study by Wilderom et al. (2009) shows many

resemblances in climate dimensions compared to the previously discussed climate dimensions. Only the empowerment dimension is unique dimension.

Climate questionnaire at operational level

For cross-checking the results of the project analyses and to find discrepancies in climate factors between managerial level and operational level, a short questionnaire with climate dimensions was taken at operational level. At the operational level a distinction is made between project managers and engineers. The sample consisted of seven project managers and ten engineers, who filled in the questionnaire anonymous, only specifying their function. The motivation for the additional questionnaire was extracted from the results of the Innovation scan and the analyses of the projects. With this in consideration, the dimensions risk-taking (from innovation scan: Lumpkin & Dess, 2001), external orientation (customer and inter-functional scales) and empowerment were chosen. The achievement orientation was not included since that scale has only two items.

3.2.2 Project investigation: Product 1

The project analyses allow for a more thorough investigation of innovation and exploration in particular. In search of suitable projects for analysis, the main criterion of the projects was the extent of exploration within the projects, but due to the lack of exploratory activities within Electro B.V. the ideal project was hard to find. One project was selected which allowed for a retrospective analysis. That project started in 1999 and was terminated in 2008. Exploratory interviews indicated that some interesting events occurred during the project. The project about Product 1 can be considered as exploratory, so regarding the research objectives it is interesting to investigate the development of the project and moreover the reasons of its termination.

The research activities considering the Product 1 project started with one exploratory interview in order to construct a time line of the project development and important incidents. Then, five semi-structured interviews with a marketing manager, two product managers, a R&D project manager, and an engineer rendered specific insights about the degree of exploration of the project. The selection of the interviewees was done by listing the people involved in the project. Then people were chosen such that the sample covered knowledge about the whole time span of the project, and employees with different functions were included.

The interviews enable the determination of elements of resistance to innovation, or more specific exploratory activities. By consciously guiding the interviews along the dimensions of organizational climate the outcomes can be linked to those contexts. The questions used in the semi-structured interviews are reported in Appendix B. The list of questions is divided along several topics and phases: introduction, research or idea phase, development up to production, production and sales, the project end, and the organizational climate. The interviews were recorded and literally written down in separate documents.

3.2.3 Project investigation: Product 2 cost-out

For the selection of the second project, the most important criteria are a high probability of finding exploratory activities in the project and the appropriateness of the project to the current climate. The selected project is a source of very recent data since it has not been finished or stopped yet. It is a project that has the most exploratory character compared to the other possible projects for analysis. The project is a so called cost-out project. It considers Electro's Product 2 system. Although it is called a cost-out project, it is an opportunity for exploratory activities since Electro B.V. demands a cost reduction of about 40% of the total cost. In order to obtain the cost reduction assumed is that the project needs a breakthrough invention and exploratory innovation is pursued to achieve the objective. The project is in a primary phase so it is an opportunity to observe the process of exploratory activities from the start with the possibility to determine the current climate for innovation at the R&D department.

From September 2009 until January 2010 data was collected from project team members by frequently assessing and documenting the new developments within the project. Observations related to the project were documented in a logbook. The observations were verified with four semi-structured interviews by confronting the involved people with the observations and asking them why some decisions have been made. Again, the interviews were recorded and written down. In this case the selection of interviewees is more straightforward since all involved employees have been involved from the start. Detailed elaboration on the projects and the findings of their investigation are reported in the next chapter.

3.2.4 Data analysis

In the next chapter, first the data from the innovation scan is presented. The statements about the innovation scan are based on the average value of the items per scale. Also, the average standard deviation of the item's scores is considered. A large standard deviation of, for example, 1.0 or more means that there is a large inconsistency between the answers on the scale and that the perspective of the management regarding that scale is not unified. The description of the organizational climate is supported with findings resulting from the climate scales.

The analysis of the innovation scan has both a quantitative and qualitative character. It starts quantitatively by determining values of the scales and then the further interpretation will be qualitatively. This is mainly caused by the relative small sample size. The results of the innovation scan were presented to the respondents in a presentation, which was the input of a discussion session about innovation between the respondents. As a result of that discussion, the climate dimensions were measured at the operational level as well.

The outcomes of the exploratory interviews were used to construct a chronological overview of the projects. The data from the semi-structured interviews, documents and other observations are transcribed into short project descriptions. The project descriptions are reported in Chapter 4, 'Results'. In these descriptions an emphasis is put on climate aspects for innovation, which are expressed in opinions and perceptions of the respondents. If delays or difficulties have occurred within projects, its causes are formulated and linked to climate aspects where possible. The events and actions in the projects provide more objective data than the personal opinions of the interviewed employees.

In the 'Analysis' chapter, answers to the research questions are provided. In that chapter the results of the data sources are compared and linked to theoretical concepts. It is no coincidence that concepts in the theory and the analysis show similarities. In qualitative research the determination of important concepts is done in parallel with the first data gathering activities. This allows for further specification of concepts, obstacles and solutions (Pope, Ziebland & Mays, 2000). First, a characterization of the organizational climate is made by denoting shared climate dimensions from the innovation scan, the Product 1 project and the Product 2 cost-out project. This is done by evaluating the concepts from the theory chapter and then by discussing the extent to which they are found in the data. Then, the obstacles to exploratory activities are determined for answering the second research question. Here again obstacles, determined in the theory chapter, are compared to the constraints that emanate from the results. The obstacles may address the climate but also factors regarding the organizational structure of the R&D department. Finally, solutions based on literature are provided for eliminating the obstacles.

4 Results

This chapter presents the results of the innovation scan and the results of the climate measures of the questionnaire at operational level. The last two sections extensively describe the projects Product 1 and Product 2 cost-out in which the organizational climate is assessed in-depth.

4.1 Innovation scan

The values of the scales used in the innovation scan are summarized in table 4.1. This section continues with a descriptive elaboration of the results. While following the 'competencies for innovation', an emphasis is put on dimensions related to exploration and the organizational climate.

Innovation performance

In general the innovation performance is regarded low. The success measures show that innovation projects have a long throughput time and are not finished within time and budget. The entrepreneurial orientation, including the dimensions pro-activeness, innovativeness, risk-taking, and competitive aggressiveness, is moderately low. The low score in the latter dimension indicates that Electro B.V. is not very aggressive in becoming a leader by eliminating competitors. An indicator of the low innovation performance is that only 3% of the products sold from 2006 to 2008 was regarded as new.

Risk-taking
The construct on *risk-taking* does not show a shared perception. The average value of 2,89 implies a moderate willingness for risk, but the high corresponding standard deviation of 1,03 shows that some managers regard Electro B.V. as a risk-taking company and others see Electro B.V. as risk-avoiding. This result means that regarding the strategy for innovation, there is inconsistency about how to handle with activities that bear large risks. There are different perceptions about the company's preferences for risky actions, but also differences in perceived personal need for high-risk actions. In a discussion session is suggested that the PROLaunch risk classification system affects the perceptions of risk. In this system all projects are classified in one of five risk classifications. From low to high risk classifications these are named runner, minor repeater, major repeater, stranger, and alien. The higher the risk classification, the more conditions must be met while proceeding a project. One manager notes that officially in an alien project Electro's CEO must be in the gate committee.

Organization of innovation

The competence that considers how innovation is organized shows typical characteristics that can be expected in a large company. These are for example a high focus on processes, formalization, and exploitation.

Exploration & Exploitation
Exploitation scores structurally higher than exploration, but according to the management both are important in Electro B.V.. This conflicts with the output of exploratory and exploitative activities since only 3% of the sold products were new. In addition, the investments done for exploration are lower as well. An absence of exploratory thoughts is not visible, but within exploration the introduction of a new generation of products is more important than entering new technological domains. Entering new technological domains could be regarded as more exploratory than developing a new generation of products. As could be expected everyone agrees with statements regarding the decrease of production costs and other exploitative goals.

Money is not the main limiting factor for executing exploratory activities. The budget for exploratory activities is 20%, but only 10% of the available hours are spent on exploration. Thus, exploratory activities are constrained by the amount of human resources dedicated to exploration. Innovation activities have been executed with governmental support, but these activities are not formally managed in the company.

Environment
Electro B.V. operates in an environment where its products do not become obsolete very fast, which implies that after the development of a product, the product can be sold during a long period. One would then expect that the market, in which Electro B.V. operates, is quite stable. Though, the product portfolio is regarded are as diverse. The different product lines (medium-, low voltage and components) can be a cause for a high score on product differentiation, which shows that Electro B.V. operates in a rather board, but stable environment.

Innovation process
Regarding the phases of the innovation process, the search phase is underdeveloped. On the one hand the awareness of technological developments in Electro B.V.'s market is considered high, but on the other hand it is not clear how that awareness is acquired. There seems to be a lack of policies and instruments for determining new trends and technologies. Due to missing instruments for the selection of innovations, the opinions about how innovations are selected are diverse. For example, some managers think that all projects are systematically ordered along their business potential and then the best one is chosen, but other managers do not agree with that.

Electro B.V. appears to be best at implementing innovations. This results from a close collaboration between marketing and the product development in R&D. The use of the PROLaunch system is probably a reason for a high measured formalization. It is not unusual that in large organizations the degree of formalization is high. It is related to a firm's abilities of innovation implementation, but the formalization is about to predominate over the whole innovation process since during one of the interviews an engineer stresses*: "The formalities in this company have a negative effect on innovation."* In spite of the structured development process, projects take a lot of time to finish.

About the evaluation and learning of projects conflicting opinions are determined considering the high deviation of the results. With respect to software tools, a low score is determined for their use in evaluation activities. When PROLaunch is excluded as a software tool for the evaluation of innovation projects, no other software tool is used for that purpose. On average there are evaluation processes for innovation projects, but there is no agreement about the extent of evaluation. The results of the evaluation are sometimes difficult to access within the organization. Learning about experiences with innovation projects is a relatively undeveloped phase of the innovation process. Mostly the documentation and distribution of gained knowledge is a problem.

Human Resource Management

A small part of the innovation scan determined the allocation of human resources within the whole plant. It is clear that Electro B.V. is a production plant. 70% of the employees has a lower or medium education degree and half of the employees do operational work, mostly in the factory. This illustrates that strategic objectives of the whole plant are focused rather on production and turnover, instead of developing the latest technology.

The results of the survey do not show strong positive or negative aspects of the *human capital* at Electro B.V.. The perceptions about human capital are relatively neutral, though some aspects can be improved like the entrepreneurial attitude of employees and their ability to make use of opportunities.

Human resource policies oriented on innovation are applied more often to managerial personnel than operational and supportive personnel. This is most apparent in the possibilities for developing a network of external contacts. This is not possible for operational personnel, but stimulated for managerial personnel. Whether with operational personnel the production employees are meant, or

also the R&D engineers, is not specified. Still, the engineers could benefit from external contacts as well.

The largest part of new information and knowledge is saved, mainly digitally on network drives and all employees have access to the documents, but there is no systematic procedure for saving new knowledge and assessing existing knowledge. Employees are not stimulated to add knowledge.

External orientation

Licenses obtained or granted to partners, can be used to determine the extent of cooperation and product development with other firms. With respect to licensing technologies, Electro B.V. is not active. The absence of licenses shows that knowledge is not shared with partners. Collaboration with companies from other industrial branches can be a source of innovative ideas and technologies, but up to now such partnerships have been scarce. Learning about working methods by looking at other companies is sometimes applied, but the opinions about vicarious learning are diversified.

Inter-functional orientation
About inter-functional coordination and communication, no unified result could be obtained. A value of 3,36 and a rather large deviation shows that some managers find the inter-functional coordination sufficient; others think that it should be increased. Therefore, the inter-functional coordination can be improved by developing a clear vision about how it should be done.

Customer & supplier ties
One of the values of Electro Corporation is the focus on customers. The survey confirms this value with a high value of customer orientation. The customer ties are more profound than supplier ties and less attention is paid to activities of competitors. Customers are more likely to share information with Electro B.V. than suppliers. An often heard explanation is that suppliers may use the shared information also in relationships with competitors to Electro B.V.. But in this case it does not affect the relationship so much that trust is not preserved: both in customer and supplier relations trust is well secured. Threatening actions of competitors, like new product releases with possibly new technologies, do not provoke direct action by Electro B.V.

Organizational climate

The organizational climate construct is compiled with the dimensions *risk orientation, external orientation, achievement orientation* and *empowerment.* The external orientation, with the scales customer, competitor, and inter-functional orientation, is discussed above as one of the ‘competences for innovation’.

Risk orientation
In contrast to the previous risk-taking measure, the risk-taking mentality construct used in climate studies shows a slight tendency towards risk preference. Still, a large differentiation between answers is observed, which shows that ‘risk taking’ is a construct that is not understood very well or is not included in a shared vision.

Achievement orientation
The achievement orientation of the management is mostly focused on the achievement of the firm’s goals. Market leadership shows to be less important, but here the standard deviation is rather large. Due to the use of only two items in the achievement orientation, its strength is quite low.

Empowerment
According to the management the empowerment of the employees is high. Employees are allowed to make their own decisions. Whether they actually make decisions by themselves is investigated with the climate questionnaire at operational level. In the decision making process, employees have the possibility to propose ideas before the actual decision. A small point of restriction is the limitation for employees to deviate from the formal rules or to use their own judgment in implementing decisions.

During the discussion session, the management adds that making mistakes is not punished anymore since the new R&D manager was appointed. Also in the discussion session some managers distinguish between empowerment levels of Electro Corporation and Electro B.V.. In the global picture of Electro Corporation they find themselves having a low empowerment, but inside Electro B.V. there is more freedom to act.

Table 4.1 Scores of the dimensions of the innovation scan. All dimensions are determined with 5-point scales, unless indicated otherwise.

Dimension	Scale	Value	Stand. Dev.
Innovation Performance			
Facts and numbers:			
	Turnover 2008 (€ mln.)	€ 167	
	Development of turnover in the past 3 years	Rising	
	Distribution of turnover along product type:		
	New products/services released during 2006-2008	3%	
	Improved products/services released during 2006-2008	30%	
	Unchanged or marginally changed products/services	67%	
Entrepreneurial orientation:			
	Pro-activeness	2,70	0,60
	Innovativeness	2,41	0,64
	Risk-taking	2,89	1,03
	Competitive aggressiveness	2,28	0,96
Success measures		2,25	0,58
Organization of Innovation			
Environment:			
	Instability	2,53	0,85
	Differentiation	3,70	0,98
Exploration		3,89	0,83
Exploitation		4,17	0,73
Innovation process:			
	Search	2,92	0,83
	Selection	3,02	0,96
	Implementation	3,92	0,93
	Formalization	4,08	0,87
	Evaluation	3,22	1,28
	Learning	2,57	0,87
Human Resource Management			
	Human capital	3,24	0,79
External Orientation			
Market orientation:			
	Customer orientation	3,87	0,69
	Competitor orientation	2,67	0,74
	Inter-functional orientation	3,36	0,92
Embedded ties:			
	Problem solving - customer	3,89	0,39
	Information sharing - customer	3,60	0,76
	Trust - customer	3,89	0,40
	Problem solving – supplier	3,78	0,42

	Information sharing - supplier	3,12	0,85
	Trust - supplier	3,80	0,42
Vicarious learning (7-point scale)		4,85	1,23
Organizational climate			
	Risk orientation (7-point scale)	4,67	1,23
	Achievement orientation (7-point scale)	5,44	1,44
	Empowerment	3,78	0,69

Climate at managerial and operational level

The climate dimensions empowerment, risk-taking, customer orientation and inter-functional orientation, which have been measured at the engineer and project manager level, show some similar and deviating results to the perceptions of the management. First, the level of empowerment shows to be perceived equally for engineers, project managers and management. It scores a moderately high value of 3.8 (out of 5). Second, the perceptions about risk-taking show a conservative attitude. Both engineers and project managers score slightly lower than the management. Finally, the customer and inter-functional orientation show similar results: the engineers' scores are lower than management's scores, and project managers score lower than the engineers. The customer orientation scores above average, which is similar to the score of that dimension in the innovation scan. On the other hand, the perception of inter-functional orientation is lower at the operational level compared to the management. Overall, at the operating level the standard deviation is slightly higher than at the managerial level. The scores of the climate dimensions are presented in table 4.2, also indicating the differences between the respondent groups. The scores and the differences between the groups should be interpreted with caution since no information about the significance of the numbers is determined. This is due to the low sample number.

Table 4.2 Comparison of climate measures at different levels.

	Engineers		**Project managers**		**Management**
Empowerment	3.9	≈	3.8	=	**3.8**
Risk-taking	2.5	≈	2.6	<	**2.9**
Customer orientation	3.3	>	3.0	<	**3.9**
Inter-functional orientation	2.9	>	2.5	<	**3.4**

4.2 Product 1

This part contains a description of the Product 1 project. Product 1 is the name of one of the first home automation products of Electro B.V.. It is a system that allows to automatically control components like lights, sun screens, alarms, and smoke detectors. Factors that have influenced the innovation process are described chronologically.

Preceding activities

Before the Product 1 project started in 1999, several preceding activities regarding home automation were done. The purpose of these activities was to create new business opportunities in creating a

distinction with regular products for meter cupboards by adding home automation. In 1992 a technology was chosen based on the European Installation Bus (EIB) technology. One marketing manager argued that *"We thought that domestic houses would gain more functions in the future concerning comfort and security. We thought that it [EIB] was also suitable for home automation."* (Product manager). In the Netherlands, Electro Hengelo and Siemens founded a union with approximately 15 companies, named EIB Nederland. But the EIB technology was not pursued for a long time:

> "The product was only brand labeled and sold. It was argued that the EIB technology would survive since multiple companies were involved, but the technology turned out to be expensive and not flexible." (R&D engineer)

Therefore, in 1999 a search for alternatives for the EIB technology was started, which eventually would lead to the new Product 1. From the interviews can be extracted that this investigation was mainly done by a single marketing manager. Many respondents acknowledge that *"he was really the driving force of the project"* (R&D engineer). This marketing manager was the one who developed the business idea and defined the new product specifications. The R&D engineers were not explicitly involved in the search activities. One of the engineers explains this by saying that *"they [marketing] looked for existing systems in the market. The technology for Product 1 was already existing and used in home automation."* Up to 2003 Electro was a member of the EIB union. At that time, Product 1 was already in production. The reason for the exclusion from the EIB union was that Electro Hengelo *"did not produce any EIB related products anymore, so when competitor Hager launched that condition, we and some other companies were kicked out"* (Marketing manager). Still, in the interviews this is not regarded as a great loss.

Product 1

The new product should be applicable in newly built houses, but also in existing houses, which was not (easily) possible with the EIB technology. The approach in finding a new product was to combine existing technologies into a new product. A global search for alternatives was done by marketing and two options were determined as viable technologies: wireless communication between components or communication via the power lines already existing in all houses. At that moment the wireless technology was not yet developed extensively, so the power line carrier (PLC) principle was chosen. The technology of the PLC principle is defined by a certain protocol, which sends messages through the power line when the AC voltage signal crosses 0 Volt. As a result of the global search, one protocol was chosen, developed by Advanced Control Technologies (ACT) in the United States. That protocol, named X10, was not very reliable and not directly suitable for European PLC applications, so ACT developed a more advanced version: A10. But about the choice of the PLC principle doubts existed at the R&D department:

> "The choice for PLC was made quickly. From the beginning we agitated against it. This was in particular investigated by one of the engineers and clarified that PLC was not really a good choice. […] During the development phase, the number of people involved was not so high to say: we get to work immediately since we see ways to do it technologically." (R&D project manager)

A competitor analysis, finished in May 2000, revealed that competitors had resembling products, which relied on EIB technology, but also on wireless and power net communication (Bouwmeester, 2000). Still, within the project team there was no agreement whether the product would be sold in a new or an existing market. The competitor analysis shows that the market existed, but the project members had a strong feeling that they were operating in a new market since they did not have any experience themselves in the home automation market.

When the project started, high expectations were made about large turnovers and profits. On the other hand, doubt existed about the technical quality of the A10 protocol and the PLC technology, but no efforts were made for eliminating the doubts. The R&D project manager experienced:

> "The marketing department proposed several products. There were some rough specifications and there was a business plan for Product 1. It looked very promising with high turnover expectations, but the means we received were minimal. […] When we asked upper management for 2.5 thousand guilders for investments, they were suddenly reluctant since that was a lot of money." (R&D project manager)

Still, management exerted a lot of pressure in finishing the product in order to start selling it since a large amount of money was invested. As one of the project managers formulated:

> "We had to bring the product to the market; otherwise the project would be aborted. We finished the tests for the available products as soon as possible. The tests were done properly, but 2 or 3 years later we found out that we did not investigate some aspects of the tests enough. There was no knowledge [about those aspects]." (R&D project manager)

> "The basis was not good: Product 1. At a certain moment 'firm blindness' slipped in because investments were made. Too much work was located at single persons, for example at one of the product managers." (Product manager)

On September 11, 2001 Product 1 was released. The project team was represented by the R&D, marketing, purchase and sales department. This was a standard configuration, but the sale of Product 1 was organized in a different way than usual. Usually the products were sold via a wholesaler, who would sell to customers, mainly installers, but now also installers were contacted directly for selling Product 1. This would later result in a lesson about setting up new marketing channels for new products. First, other problems occurred which resulted to delays in the project's progress.

Delays

In 2002 the first product deliveries were done, but soon customers and installers started complaining about the reliability of the product. For example, it occurred that switches in the system switched at moments on which they were not supposed to. The project team had not expected this and was unaware of the problems to come. A cause for this could be that the technology of Product 1 was imported from outside the company and internally low efforts were made in mastering that technology. There was only one electrical engineer who could possibly solve the problems. That consumed all of his time, so further development of the product was set on hold for at least nine months. The electrical engineer was able to solve the problems on the short term, but for the long term no solution was developed.

How could those problems occur in the first place? One of the most apparent causes, resulting from the interviews, is that the testing of the product was not sufficient. Initially, the product was tested under lab conditions according to governmental standards. Before the product launch, Product 1 met those standards. One product manager comments:

> "We have never released a product that was not tested or not certified, but the actual environment [of the product] was more severe than the standards." (Product manager)

> "We have learned from Product 1 that longer testing is necessary. Not first introducing a product and then testing it." (Marketing manager)

From 2000 to 2002 Product 1 was tested in about twenty pilot houses, but here the main technological problem of Product 1 was not acknowledged since the conditions of the environment of the product is not uniform among the test houses. From the beginning, the technical shortcomings of the technology were accounted for with filters, but that was not enough. It appeared that other products in the power line net, which did not comply with European EMC (electro magnetic compatibility) standards, caused the malfunctioning of Product 1. This EMC problem was not solved until 2005. Moreover, the demand for Product 1 was increasing in that period, so there was a dilemma between stopping deliveries and first solving the EMC problem, or selling directly and solving the problems later. A marketing manager says about that dilemma:

> "From my position I always said that a delivery stop is not possible. I have had arguments about that with the product manager." (Marketing manager). The product manager confirms: "Management exerted a lot of pressure. Investments were done and results had to be obtained."

Finally the sales were continued because of the customers already involved with Product 1. From 2002 to 2005 the number of project team members was increased with a few people, of whom one was an engineer, but the new engineer did not have the right technical knowledge for speeding up the EMC problem solving. "The call for more human resources is always present, but my executive in England did, or could, not do any effort to accomplish it." (Product manager).

A second cause for a project delay and new technical problems was the production of Product 1 in China:

> "Initially we would produce in the Netherlands, but ACT recommended producing Product 1 cheaper in China. The disadvantage was that it was new for us. We could not control the quality." (R&D engineer)

The lack of control indeed resulted in quality issues. During 2003 the Product 1 systems produced in China showed malfunction due to the fact that the Chinese producer changed some components without approval. Therefore, the production was moved to the company A1 in the Netherlands. After moving the production to the Netherlands the quality was restored and also the communication was perceived as more convenient. A marketing manager commented:

> "I must admit that we did not always succeed in finding the right partners. Each time it had to be as cheap as possible".

New marketing channel

Selling Product 1 directly to customers resulted in some struggles. As one product manager explained the feedback from customers, the installers, was handled poorly:

> "During the kick-off feedback was provided directly, but nothing was done with the feedback. That is a bad thing since it was a technology driven project. An idea was worked out: this is how we will do it." (Product manager)

The bad experiences of the customers with Product 1 resulted in an absence of repeated sales. The installers that could sell Product 1 did not have the appropriate technological knowledge to install the product properly, so their experiences with Product 1 were not always positive. This was investigated by a customer satisfaction assessment and as a result the Product 1 project team started to organize courses for installers. The after-sales department was not approached for dealing with the complaints or arranging the courses since they did not have the knowledge either to serve the customers.

> "Complaints were forwarded to R&D because the customer service department did not yet have enough knowledge about Product 1 to handle it. They [the complaints] were

> investigated by our most experienced engineer, because he had the most knowledge. The number of people was too low to solve the actual problems." (R&D project manager)

The organization of the courses resulted in a delay of the improvement of Product 1 since it consumed a lot of time. Product 1 was also sold in new houses by brokers, but the experience with this market channel was that brokers did not stimulate the sale of Product 1 since it would be another increase of the selling price of the house.

In 2005 the EMC problem was solved with the development of a new print design that is used in the modules of Product 1. The print was developed in cooperation with 3T in Enschede and the number of engineers in the project team was lowered back to one engineer. Also a new 'hybrid' switch was designed, which resulted in a patent. This time the testing was done more intensive than before. Most respondents regard the starting period as a learning period in which the knowledge about the PLC technology had to be acquired together with the product development:

> "Later we found out that for the PLC principle a bulk of knowledge is necessary but we did not know about its existence. We had to extract that knowledge from the market". (R&D project manager)

Creation of a business unit

From 2006 a change of direction is observed when the marketing manager acknowledges that, when only applied in luxury houses, the PLC principle is not the long term solution for home automation: *"The offset in that market is too low"*. From 2006 to 2008 three changes were made affecting the project progress, including a change of marketing strategy, the search for an alternative for PLC and the creation of a home automation business unit.

First, in finding new ways of selling Product 1 in large numbers, collaboration with two power companies, Power company N and Power company E, was initiated. Power company N and Power company E had plans for a merger and during those plans they were enthusiastic about a new product for energy saving in houses. Product 1 could be used for this purpose, but then the product would have to be adapted.

> "We have adapted it according to Power company N's demand. We had to, and did, make a letter of intent, but it was never signed. Both sides have crossed boundaries they were not allowed to cross. We were in a euphoric mood, so we took the risks." (Marketing manager)

Investments were made and time was spent by the whole project team to adapt Product 1, but when the merger between Power company N and Power company E was cancelled, the motivation of the power companies in continuing the collaboration was low. Power company E stopped directly and Power company N followed due to a lack of internal commitment. As a result Product 1 was not used in the energy savings market, but large investments of money and time were made. Several respondents note that during the Power company N collaboration the management was too eager for making more sales and they sufficed with only oral commitment.

Second, in the same period the development of a wireless system for home automation was started. The available options for the protocol was limited to only one, named Zigbee. No alternatives were investigated because Zigbee was the wireless protocol dictated by Electro Corporation.

> "We could not just switch to another RF [wireless] system. We had to wait for Zigbee, but that protocol is absolutely not suitable for an application in European home automation." (Product manager).

Zigbee did not have the best quality and a large time pressure was perceived: *"Zigbee did not really get off the ground. That had to be done in 'no time'"*. (R&D project manager). The Zigbee product was focused on the elderly care market: another market than Product 1 initially was developed for. The Zigbee and elderly care developments are out of the scope of the Product 1 project, but the engineers involved are basically the same. Therefore a work overload was created for the single engineer involved in both projects.

Finally, at the end of 2007 a business unit was created for home automation, including Product 1 and Elderly Care. The business unit's members were located together in a separate location of the building. In general this was perceived as a positive change:

> "Before the business unit Product 1 was spread through all departments. At R&D not much output was observed from the Product 1 engineers, so R&D managers started to ask for their skills in other projects. […] The creation of the business unit was a considerable improvement! We got more structure, more people, and more breathing air. Things went better, but the lag was already there." (Product manager)

It also increased the motivation of the employees. This lasted only for one year since in 2008 the business unit was set on hold due to a pending acquisition of Company M by Electro Corporation. Company M had a similar wireless system, System X, which had a better performance than Zigbee. This caused an uncertainty about the future during 2008, because in case of an acquisition, System X would be the new wireless system. As a result short and long term objectives were unclear. At the end of 2008 Product 1 was stopped after the acquisition of Company M. A product manager illustrates the creation of the business unit:

> "The business unit manager was able to make a structure in a short time on the condition that he got some functions in his team. But he did not receive some key functions: again no commitment." (Product manager)

To summarize the developments in the Product 1 project a time line shows the main events of the project in figure 4.1.

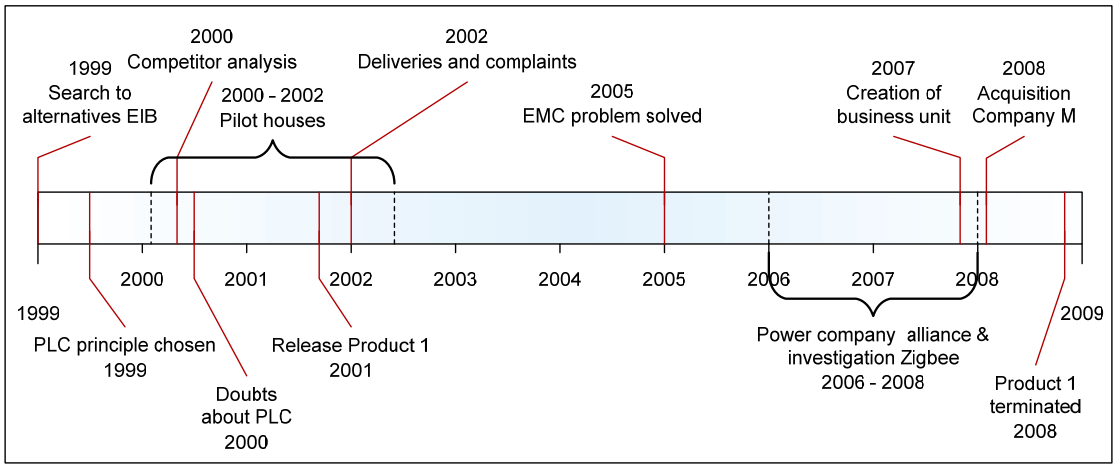

Figure 4.1 Product 1 time line, indicating the most relevant events.

4.3 Product 2 cost-out

The second project description examines Product 2 cost-out. The Product 2 is a medium voltage system which operates in the power net in the voltage range of 12 to 24 kV. Products operating in this

voltage range are called ring main units. The Product 2 was developed around 1995. At this moment it is still the most advanced ring main unit of Electro B.V.. The project description is rather chronological, but due to the short period of analysis, the paragraphs are also named after topics which emerged during the interviews.

Preceding activities

From 2003 to 2005, one major cost reduction project has been executed for the Product 2. Regarding this previous cost-out project, a presentation of October 2003 shows that three kinds of cost-out activities were presented: short term low risk activities, long term medium risk activities, and high risk activities that need technology studies. The short term activities considered easily achievable tasks and they were realized. Regarding high risk activities, found in technology projects, only a limited number was done. One technology was implemented in 2009: four years after the project had finished. This shows that the cost reducing activities have been present during the last seven years and that in the first cost-out project easy achievable objectives were realized.

Officially, the last Product 2 cost-out project was finished in 2005, but since cost-out activities were continued after project closure, several employees had the idea that a new cost-out project was necessary. In the beginning of 2009 the current R&D manager, who at that time was working at another department, was assigned as a responsible for those activities. He comments:

> "Someone had to be assigned in order to keep the activities going on. It was not a formal project and I had no time, but it was important not to lose the attention on the Product 2 cost-out".

In the following months the responsibilities were shifted to several people: first a project manager who is leading the project at this moment. He was too busy, so an engineering manager took over, but he only managed some activities of Chinese employees who were present and in need for work. At the start of this research the responsibilities were shifted to the current project manager and the data collection was started.

Project specifications

The current Product 2 cost-out project was started in the R&D department around July 2009. During the following months the amount of the cost reduction has been a large point of discussion. In September was evaluated that one Product 2 system costs about €4500,-. When the material's costs are subtracted from the total costs, an amount of €3000,- is left. This is the cost which can be influenced. In September it was stated that that amount must be reduced with €1500,-. However, in October the project manager received an e-mail of a marketing manager in which was formulated that *"if the cost reduction is about €500,-, it is also okay"*. The project manager was surprised since he was preparing for a much larger cost reduction. In the following weeks the uncertainty about the amount of cost reduction remains. The project manager says that *"nobody exactly tells me what the cost reduction is going to be."*

Although in August the Product 2 cost-out project had started in the R&D department, only in November the project is officially launched. Within R&D this starting presentation is not regarded as very interesting: *"It is just a formal meeting for the marketing department to start the project."* Still, two hours before this meeting there is indistinctness about the target for cost reduction: R&D management thinks that it is €1500,-, but the project manager had assumed €1000,-. Finally, a target of €1500,- is set to be met at the end of the project, which is about to last for three more years.

One of the discussed topics in the interviews is how the amount of cost reduction can be achieved and how the project team members perceive the goals. The set target shows to be not very motivating. About the target some employees comment:

> "That €1500,- is not doable." (Project manager)

> "I think the expectations are way too high. According to me it is just not achievable. I don't know what it is based on. Maybe it is just some kind of game." (Engineer)

Investigation of the origin of the target reveals that the marketing department has calculated that such large cost reduction is necessary since the market price for comparable products is going down. A lower selling price is necessary to remain competitive with the Product 2. Yet in April 2008 the Product 2 product manager and product manager of the marketing department have presented a plan for the next four years in which the cost reduction is estimated at €1450,- and a sales volume growth of 1500 units, reached in 2012. They propose several key success factors like a dedicated project team, a fulltime project manager, a clear focus, specific targets and actions, and third party support and ideas. This shows that the cost-out plans for the Product 2 have been developed in a period before the current cost-out project was initiated.

One of the most profound constraints that are perceived by the team members is the limitation to actually change the product in ways they think is necessary to obtain the targeted cost-out. The boundaries are comprised in the project's specifications. Two forms of limitations are perceived: specific actions that are not allowed, and ignorance about the desires of the management. Considering actions, this cost-out project is treated like any other cost-out project that is done, resulting in employees making statements like:

> "The feeling and touch of the product must remain the same. The customer may not notice that the production has become cheaper." (Project manager)

This means that radical new innovations, which result in a large cost reduction, seem not viable since customers may begin to doubt about the quality of the adapted product. Even more, they also might demand lower prices.

The second aspect related to the project boundaries, is the management's specification of what actually can be changed within the project, instead of what can not. This is not clear for the project team. While thinking about possibilities to adapt and change the product some employees reflect:

> "In the coming years I will achieve cost-outs by grasping the low-hanging fruits which are small and simple improvements with reasonable cost reductions." (Project manager)

> "We must think of something extreme, but I don't see it happen. I have asked for the project's conditions, but I just do not get an answer. […] I have never seen a paper with the assignment." and: "It must be clear what you can touch and what not." (Engineer)

Through such doubts and a lack of clear specifications, the team members question the importance of the project. Although specifications are absent, excel sheets and text documents have been made where specific topics for cost-out are articulated: the so called low-hanging fruits, but these topics are only based on indirect deductions about the project's scope.

Priority and resources

> "The Product 2 cost-out project is one of the most important current projects within Electro's R&D department. […] But first other projects on the Product 2 must be finished." (R&D manager)

The other projects are projects that add functions to the Product 2 like remote control and internal arc control. Their appropriateness is regarded in two ways: the projects will only create a higher cost for the Product 2, but due to the better functionality, other parts of the product may become obsolete.

Closely related to priority setting are the direct actions resulting from priorities. According to the team members, this could be expressed through commitment by denoting resources and planning, but:

> "The priority looks to be one of the highest, but as it is planned: it is not planned. […] Officially, three engineers are assigned to this project, but the other two engineers are not available. Sometimes, even I have to do some other activities. That is when the engineering manager tells me to." (Engineer)

When investigating the last comment, it appears that the single engineer, who officially is working fulltime on Product 2 cost-out, is occasionally assigned to other activities. Even more, the project manager admits that he is not solely dedicated to the Product 2 cost-out project:

> "At this moment [December 2009] I spend much time on the Modava project, but also on Unitole and Product 2 cost-out. One engineer is working on Product 2 cost-out. The rest will join later." (Project manager)

One could wonder whether the project manager feels any pressure since only one engineer is available and the project does not progress very fast, but that is not the case. He comments: *"I do not perceive any time pressure: I have no resources, so why should I? This project can last up to four years."*

Also employees from outside R&D are assigned to the project team. The effectiveness of the cross-functional teams in Electro B.V. has recently been investigated (Hutschemaekers, 2010). In that study is concluded that the cross-functional teams do not function very well since there is a lack of communication. This is also observed in the Product 2 cost-out project:

> "Officially we meet with the other departments once a week, but usually I end up with only the project manager. It is not clear what the responsibilities of the other departments are." (Engineer)

Besides human resources, assets in the form of test facilities are a form of resources as well. When asking employees about the tangible resources for innovation they do not perceive a shortage of test facilities. Instead the emphasis is directly put on other aspects:

> "The test facilities are no source for constraints; it is rather the mentality to use them: project leaders and managers must allocate time." (Engineer)

Search activities

The real time involvement in the R&D department allows determining the climate considering exploratory activities. In searching for new technologies for the Product 2, several ideas were proposed like organizing cross-functional brainstorm sessions, contacting suppliers and outsourcing development to other companies.

Initially, for October 2009 brainstorm sessions were planned. A large number of people would be asked to participate: engineers, but also external companies and employees from other departments like assembly, production and supply chain. Several groups were made to have parallel brainstorm sessions, also allowing for mixing the groups after each session, but in the end the brainstorm sessions were cancelled. The reason for this was that:

> "The brainstorm sessions have been done twice during other Product 2 cost-out projects. The participants have already suggested their ideas, so by repeating them, no new ideas will be proposed and it will only be a waste of everybody's time." (Project manager)

Regarding cooperation with suppliers, the project manager has contacted one supplier that could provide solutions to cost reduction by developing a plastic housing instead of the current metal one. The supplier was asked to look into three aspects of the housing and made an offer considering the three aspects. The engineer who is working on other specific aspects of the housing is confused about the role of the project manager since he notices that *"the project leader is involved with the construction"*, but the engineer does not know exactly what he is doing. About collaboration with suppliers he says:

> "Cooperation with suppliers could result to new solutions, but that is hard since I did not spend much effort to it last years." (Engineer)

Three reasons are put forward for the low efforts on contacting suppliers. First, it does not match with daily practices since *"engineers only have to think of something and make a drawing."* Second, occasionally an engineer's superior prohibits initiatives to external contacts since the engineer would not be entitled to do so. A third reason is that the purchase department sometimes denies a proposal for new suppliers or parts. One engineer adds that: *"there should be a technical purchaser since regular purchasers only look at the price, not functionality."*

For outsourcing the technology development, the Indian engineering company Tata was approached. Tata is known within Electro B.V. as a large company with engineers who can decompose the product into small pieces and then rebuild it in a much cheaper way. The project manager notes that two sessions were done with Tata engineers, but then the activities were blocked by higher management since they were anxious about the preservation of the intellectual property comprised in the product. Management stresses that cooperation with an Electro department in China should be leveraged, but not much enthusiasm can be observed from the R&D employees:

> "They [management] say that I have to work with 'China', but they do not say how. In China the engineers don't know what to do. They provide no added value for me. It only costs time." […] "They do not apply any quality related management. They only deliver parts." (Engineer)

Besides above described attempts, nobody in the project team, or even in the whole R&D department, is charged with searching for new technologies. One engineer remembers:

> "One year ago there was an innovation manager really taking care of innovation: new technologies and new possibilities. He left, but was not replaced. One of the engineers was assigned to take over, but he has no time for it." (Engineer)

Still, even without formal procedures for searching new ideas, ideas are generated by the individual employees. For these ideas, there is a lack of a selection method. Therefore, the activities pursued in idea search and generation totally depend on each specific engineer. Some take initiatives by visiting seminars about their field of work, which they then discuss with their superiors. One engineer comments *that "there are no procedures for idea generation. If people have ideas, they must bring them to the management."* On the one hand, in the case that someone has an idea, it is received well among the employees:

> "Even when you are beginner in this field, like me, nobody had problems with my ideas. Collaboration at that point is really okay." (Engineer)

On the other hand, the supply of really innovative ideas is poor. A shared perception of the R&D employees about creativity and technological expertise is that the R&D department is dependent on a single engineer:

> "There is one engineer who comes up with ideas. If one of his ideas is good, it becomes a project along the way. He is also responsible of all technical aspects of medium voltage systems." (Engineer)

Daily activities

The organizational climate can be described by observing 'how things are done'. When the respondents reflect on their own work or the work done at R&D, several characteristics are proposed. Typical statements heard are:

> "Engineers copy the work and skills of yesterday to today." (Project manager) and "It is a matter of applying a well known concept in a different position. A material is moved from a place where it is known to a place where it is new. That is the innovation." […] "We don't have a research department. No wonder that my manager has the function name of engineering manager. Actually, we are an engineering department." (Engineer)

This incremental form of innovation is acknowledged through the whole department. A possible step towards more radical innovation outputs is provided by the Product 2 cost-out project manager: *"A new development can only be done when some engineers are released from serving the production department."* During the months of analyzing the Product 2 cost-out project, the management had some ideas about combining exploratory and exploitative activities, for example by granting every employee 15% of their total time to spend on 'innovation'. This proposal is received with a little doubt:

> "When doing other projects, free spendable time for innovation, say 15%, diminishes quickly. It must be structurally implemented. […] At this moment I am not assigned to any project by coincidence. I can do what I like and can be innovative, though the outcome may be for the purpose of cost reductions in several products." (Engineer)

Another engineer stresses the influence of a project manager on the activities done by the team members:

> "Project managers do not explicitly assign time for innovative things. They look at time and budget, so you get the fastest and easiest incremental solutions, since for that we have the most knowledge; it is easier, faster and cheaper." (Engineer)

Technology projects

While assessing the exploratory activities within the R&D department, attention must be paid to the existence of 'technology projects'. These projects are not related to the Product 2 cost-out project, but they were also active during the data gathering period. A large part of all R&D engineers are (part-time) involved in technology projects, which are framed in the 'Knowledge Management' program. This program has the purpose of providing the inexperienced employees with knowledge from the experienced employees. It consists of four aspects: competence development, project scoping, technology projects, and 'Design for Six Sigma'.

Since August 2009, after the previous R&D manager left, the attention to Knowledge Management and the technology projects has diminished. Before, the Knowledge Management program was perceived as a formality and no much effort was put into it. Employees reflect that the R&D manager at that time was not a motivator: he dictated what had to be done. The Knowledge Management program is integrated within the running projects of the participants. This caused a certain entanglement:

> "Due to the incorporation of the knowledge management program, the boundary between knowledge management and product development activities is blurred." (Engineer)

As a result more time was spent on product development in regular projects and less time was devoted to Knowledge Management. This was in particular the case for the technology projects since the engineers in the technology projects were not accounted for their activities regarding technology progress. With respect to the Knowledge Management and technology projects the engineers perceived no pressure and they were waiting for clarifications:

> "You need sponsors who receive the order of the manager to spend some time with a person that is participating. It is not working now because it is not scheduled." (Engineer)

In the beginning of December 2009 one engineer expresses that *"the R&D manager stresses the importance of technology projects. Before him no emphasis was put on them."* During a Knowledge Management meeting January, again, the participants do not know how much time they are to spend on Knowledge Management and in what form it will continue. It is decided to put the Knowledge Management program on hold until further notice.

5 Analysis

This chapter provides an analysis of the situation at Electro Electrical B.V. regarding climate and exploration. First, characteristics of the organizational climate at the R&D department of Electro B.V. are described. Then, the obstacles to exploratory activities are determined, discussing the extent to which obstacles discussed in the second chapter or other manifestations of the organizational climate and structure have obstructed exploration. Finally, measures and desirable situations are derived that reduce the negative effects of the obstacles to exploratory activities.

5.1 The present organizational climate

The current climate for innovation of the R&D department can be described as passive. The main part of the employees at operational level has an attitude of expectation, which expresses itself in a low level of initiative. Employees are not eager to explore new technologies. They rather possess a mindset for exploitative innovation. Before exploratory activities are initiated, the employees at the operational level expect some approval and encouragement from their executives.

This section elaborates on the climate by assessing the concepts formulated in the second chapter. Table 5.1 provides on overview of the concepts and the main findings, answering the research question:.

- *What does the current organizational climate at Electro B.V.'s R&D department look like?*

Table 5.1 Characteristics of the determined climate dimensions.

Dimension	Characterization
Risk orientation	Product 1: high Product 2 cost-out: low Management: diversified
External orientation	High customer orientation Low competitor orientation Poor inter-functional coordination Supplier ties
Achievement and task orientation	Results focus Adherence to rules Goals do not trigger to excel
Vision	Past, Product 1: clear Present, Product 2: poor
Participative safety	High empowerment Low involvement/interaction
Support for innovation	Articulated support Low enacted support

Risk orientation

Risk orientation has shown to be a crucial factor in innovation and climate literature (Levinthal & March, 1991; Nystrom, 2002). Resulting from the innovation scan, the differentiated view on risk of the management argues that the climate is neither directly in favor nor rejecting towards risk taking. This may be good for combining exploration and exploitation, but the actual consequence is that the management has developed a defensive attitude towards risk in any new project. This is caused by a

new product development (NPD) tool that strongly stimulates the decrease of risks regarding negative outcomes of projects. In this tool, the increase of a risk classification of a project also means an increase of formalization, which is regarded as a negative aspect of the innovation process. Automatically, also innovation projects which are executed in the NPD program will suffer from the risk lowering tendency and therefore they become less exploratory.

In the Product 1 project, the risk orientation can be considered high. Lumpkin and Dess (2001) describe risk taking as "bold actions such as venturing into unknown new markets, committing a large portion of resources to ventures with uncertain outcomes" (p. 431). The developments in the home automation market, which was an unknown market for Electro B.V., can be seen as risk bearing. In climate literature on innovation, risk taking is related positive to innovation outcomes (McLaughlin, 2005; Nystrom, 2002). As denoted by employees, the switch of Product 1's marketing strategy came with risks as well, but instead of the success stories of risk in literature, in the Product 1 case the high risks led to unsuccessful business.

On the contrary, the activities in the Product 2 cost-out project are not of a high risk: not in the past and not in the present. Each time the easy objectives with low risks are achieved. The two projects show that the risk orientation is not high or low, but the fact that the Product 1 project was initiated 10 years ago may suggest that the climate regarding risk has changed to a low risk orientation.

External and market orientation

The results of the external orientation in the innovation scan enable a critical view on the climate.

First, the strong customer orientation has a large manifestation in the organizational climate. In the current climate for innovation, the mindset is such that new innovations should fit to existing customers' demands. In theory, a high customer orientation in Narver and Slater's (1990) *market orientation* is not considered as a problem, but the current climate rather focuses on existing customers than on new customers and markets.

Second, the results of inter-functional coordination, being a part of the external market orientation, show a discrepancy between perceptions of the management and the employees at the operational level. The effective execution of inter-functional team work is lower than the management thinks. An example of the poor operation of the cross-functional teams is that delegates of other departments do not attend meetings. An explanation can be found in the low contribution that may be perceived by those employees. If their cooperation is not valuable, their commitment will decrease.

Regarding the projects, the ties with suppliers show some differences. In the Product 1 project, the supplier relations and partnerships have been dynamic. While looking for a good balance between costs and quality, production switched to Chinese producers and back to Dutch manufacturers when the quality proved to be low. In the Product 2 cost-out project only a few attempts were done to involve suppliers in the improvement process. The project manager was often the initiator since these activities are not familiar to the engineers.

The customer orientation in the Product 1 project was high. Here especially the focus lied on new customers, which is positive for innovation. In the Product 2 cost-out project customers were not involved and the existing customers were most important.

Achievement and task orientation

The achievement and task orientation was formulated as the willingness to excel, with a focus on reaching goals. During the last years, management has expressed a large emphasis on getting results and increasing turnovers. This explicit achievement orientation focuses on exploitative goals. Therefore it has led to a focus on short term gains and it has diminished the importance and execution of exploratory activities. Priorities are set on exploitative activities by means of resource allocation and the project portfolio.

During the early developments in the Product 1 project, the final product characteristics had a central position in the development process. Even when coping with setbacks, the exerted pressure to keep making sales during development is an expression of a high focus on results. This shows the desire to excel in profitability, rather than in excelling in technological innovation.

The goal in the Product 2 cost-out project is mainly expressed through the emphasis on the amount of cost reduction that must be achieved. Just like previous cost-out projects, the emphasis is put on easy achievable cost reductions, but these do not match with the high targets set for the final outcome of the project. This is an indication that the achievement orientation is not high within the Product 2 cost-out project. The most important exploratory activities are postponed.

Vision

The climate is affected by the vision shared by executives, and the vision perceived by employees (Sarros et al., 2008; West, 1990). The activities in the Product 1 project initially were stimulated by a vision. The project was basically founded on the vision of what the product should be capable of and that the new product would unlock new markets. In spite of some troubles, each time a new plan was made to continue the project. Still, at the end of the Product 1 project uncertainty was perceived about the future since the management did not transfer a clear vision due to the pending acquisition. At that point the climate for innovation was affected negatively.

In the Product 2 cost-out project a low degree of vision articulation has affected the team climate. In the project, confusion is created by contradicting statements and the perceived absence of a management's vision. In West's (1990) model, the attributes of vision are *visionary nature, clarity, attainability*, and *sharedness.* After a short period the project's goals were clear, but the plan about what is possible or not remained ambiguous. That is an indicator that the *clarity* of a vision was poor.

The lack of clarity about approval is caused by a poor vision transfer from the management towards the operational level. It creates a climate where assumptions take the upper hand of the actual vision, resulting in exploitative activities: a form of activities that has been approved in the past. Since the goals in the project are regarded as "not doable", the *attainability* of the goals is clearly low.

Vision and leadership style are often connected in literature on climate, culture and innovation (Lin & McDonough, 2009; Panuwatwanich et al., 2008; Sarros et al., 2008). During the last year the Knowledge Management program at the R&D department was continued, but without any sign of leadership activities. The lack of leadership and vision created a climate of indifference and passiveness.

Participative safety

In West's (1990) *participative safety,* the interpersonal atmosphere of trust and support is a condition for a climate for innovation. McLaughlin et al. (2005) make a distinction between internal and external trust. Internally, in the Product 1 project team, trust or confidence was poor. Different views on technological aspects caused internal friction. Also marketing-wise conflicts arose about stopping or continuing production. Externally, the marketing employees built relationships on high levels of trust, which in literature is seen as beneficial for innovation (West, 1990). On the other hand, having a high level of trust and a low formalization of the external relationship creates the chance for opportunistic behavior. In the Product 1 case this situation resulted in Electro B.V. doing investments without any formal commitment by the other partners. The focus on outcomes has suppressed team members to affect decisions. The members of the project team did not successfully act against the pressure to perform.

Considering Product 2 cost-out, the fact that the management was not able to eliminate doubts, shows that the involvement of the employees is low. In general, there is a low formal argumentation of the reasons of the decisions made. It does not trigger anyone to question decisions. They are taken for granted. When considering freedom to act and the support of initiatives, some limitations are observed

like management's intervention of outsourcing towards specific companies or the restriction of initiatives that could lead to cost reductions, but which would change the product's appearance.

Regarding the 'involvement' within *participative safety,* a remarkable aspect of the organizational climate is the high determined level of empowerment. Both at managerial and operational level the empowerment is high. It shows that in the current activities the employees feel free to suggest ideas and to influence decisions. An important note is that at this moment, the perception of empowerment is part of a climate supporting exploitation. The perceptions about freedom to interpret rules or to influence decisions affect the current tasks of incremental product improvements. It considers the work that is assigned to the employees, not the extent to which exploratory activities are empowered. With respect to exploratory activities it is hard to evaluate the level of empowerment from the innovation scan.

When looking at the results of the Product 2 cost-out project, it is hard to confidently confirm a high empowerment. As Ahmed (1998) finds that empowerment is a result of good conditions of a climate for innovation, questions can be placed about the existence of those conditions in the R&D department in the first place. For example, a sharing leadership style is beneficial for empowerment (Harborne & Johne, 2003), but clear expressions of leadership are not found in the gathered data on the Product 2 cost-out project.

Support for innovation

The distinction between articulated and enacted support is clearly observed within the projects. In the Product 1 project there was articulated support, for example when the decision for the collaboration with the power companies was made.

On the other hand there was a lack of enacted support: in difficult times money and human resources were not provided to the project team. Also in the Product 2 cost-out project enacted support for innovation is poor. The project description in the previous chapter indicates that the support for innovation is low due to the current structure of resource allocation.

It is easier and cheaper to provide articulated support than enacted support. Enacted support costs money and time. The innovation scan shows articulated support for exploration, but actions to devote corresponding resources to exploration are not taken.

5.2 Obstacles to exploratory activities

This section determines the main obstacles to exploratory activities that are present in the R&D department of Electro B.V.. Although the main research context of this study is the organizational climate, the results show that also structural aspects can limit exploratory activities. The climate aspects are risk orientation and vision. The competency trap, a poor organizational structure and low slack resources are determined structural aspects. The topics are listed in table 5.2. This section answers the second research question:

- *What have been the obstacles to exploratory activities for the R&D department of Electro B.V. in the context of the organizational climate?*

Table 5.2 Overview of the topics in which the obstacles to exploration are found.

Topic	Characterization	Structure or climate
Risk orientation	Risk averse climate	Climate
Vision	Lack of vision	Climate
Competency trap	R&D focused on exploitation and existing technologies. Short term achievement orientation	Climate & Structure
Organizational structure	Entanglement of exploration and exploitation Lack of resource allocation for exploratory activities	Structure
Slack resources	Low support for exploration Occupied resource base	Structure

Risk orientation

The importance of a risk orientation is stressed in literature on exploration but also in literature on climate (Levinthal & March, 1993; Nystrom et al., 2002; Sethi & Sethi, 2009). The low risk orientation at both the managerial and operational level is a constraint for exploratory activities. As denoted in section 5.1 the struggles at managerial level regarding risk orientation are caused by a variance in the risk perception among the managers. An explanation for the moderate risk orientation can be that the opportunities of doing projects with larger risks are not yet understood since there is no experience with such projects.

At the operational level, the risk perception reflects the degree of risk-taking that is executed in daily activities, but these activities are managed by their executives. Therefore they largely influence the risk perception of the operational level employees. In addition, the gap in risk perception between the management and the operational level is not directly a cause for low exploratory activities, but it implicates that there is a level of risk which is supported by management, but not taken by the operational level. As a result less exploratory activities are executed than when the risk perception of the operational level would be equal to the managerial perception.

A too low risk orientation can be an obstacle for executing any exploratory activities, but a high risk orientation can be disadvantage for exploration as well. In the Product 1 project risks were taken under circumstances in which the risk-taking was not restricted. This is in accordance with Ahmed (1998), who prescribes boundaries for risk-taking in order not to exaggerate in risk bearing activities.

Vision

At this moment, the management's vision about the employees' activities is not clear. A small number of employees spend their time on exploratory activities, but the majority does not execute exploratory activities spontaneously. The poor perception of a vision can be depicted by events in the Product 2 cost-out project which contain aspects of the vision dimensions *clarity* and *attainability* from West (1990). Section 4.4 shows that the unclear motivation about the reasons for the goals is a main constraint for the clarity within the project. Not knowing what is possible or when it is possible has caused a passive attitude. The passive attitude is observed in the whole R&D department and the lack of a clear vision has caused it. More specific for the Product 2 cost-out project, the height of the targets has caused a low perception of attainability. Targets which are regarded not achievable do not inspire employees to execute exploratory activities which are deviating from regular exploitative activities.

Although in the Product 2 cost-out project a lack of vision was found to be a main obstacle for a climate for exploration, also at the end of the Product 1 project the low attitude towards exploratory

activities can be ascribed to a lack of vision. It shows that when a path for the future is not clear, an emphasis is put on safe, exploitative activities.

Competency trap

The innovation scan shows that Electro B.V. is suffering from the competency trap as described by Levinthal and March (1993). In the R&D department an emphasis is put on the capabilities that have been acquired in the past and which deliver profits with higher certainties. Indicators are the low budget that is spent on exploratory projects, but also the exploitative nature of the products released over the last period. A link with the Product 2 cost-out project is found in which the engineers copy the activities from past to the present. In research and development activities a focus lies on well known technologies, which is a typical for the familiarity trap described by Ahuja and Lampert (2001).

The results of the Product 1 project show that a lack of technological and market knowledge caused difficulties in executing exploratory activities. On the one hand this is ascribed to a low number of employees who actually posses the knowledge, but on the other hand the project team has not been capable of obtaining the right knowledge in the first place. The inability to acquire knowledge has been determined as an obstacle for exploration (Yukl, 2008). As a result, existing knowledge is exploited.

The low amount of exploratory activities due to the competency trap is even more enhanced by the climate dimension achievement orientation. The focus on short term results explains why the currently held competences are emphasized and exploited.

Organizational structure

The organizational structure of the R&D department is constraining exploratory activities in two ways: activities are entangled and a mechanism for approval is absent.

First, in structural ambidexterity literature the main challenge is to separate exploratory and exploitative activities. In the current R&D department a separation has not been implemented through the organizational structure and a strict separation might not be the best solution. Therefore, the challenges in executing more exploration are similar to the challenges found in contextual ambidexterity. Exploratory activities can be obstructed due to an entanglement of exploratory and exploitative activities (Gibson & Birkinshaw, 2004). According to the respondents, exploratory activities are not separately scheduled, but they are entangled with regular activities. In the current R&D department this entanglement has caused the diminishment of exploratory activities since a natural tendency towards exploitative activities is observed. A separation of hierarchical levels is observed since the attitude of expectation shows that unless the management approves activities, not many initiatives are taken.

Second, the organizational structure does not account for a mechanism which facilitates the initiation of innovative ideas and the development of technologies which are not yet related to product developments. These ‘search’ and ‘selection’ phases as denoted by Tidd et al. (2005) are the main conditions for effective exploratory activities. The Knowledge Management program was an opportunity for technology development. The termination of that program has resulted in a situation in which the organizational structure has no specific allocation for exploratory activities.

The absence of an idea management process is a constraint to exploration related to the structure of the R&D department. Idea generation and the idea search process are essential in exploratory innovation (March, 1991; Tidd et al., 2005). At this moment, employees are unaware of the possibilities for posting new ideas. For exploration, these ideas should not consider the activities of their daily work, but ideas about opportunities to set up a new business or about new technologies that should be investigated. As of yet, new ideas from the operational level are only created by a single employee. This dependence is unfavorable for the organizational climate since it supports a passive attitude of the other employees.

If an innovative idea is selected for further development a next barrier for success occurs. The explorative and exploitative ideas that enter the PROLaunch system as projects, are likely to be finished due to a high level of professionalization of the implementation phase. This phase is characterized by a high degree of formalization. Formalization helps to pull projects through the NPD process, but too much formalization is an obstacle for exploratory projects (Jansen et al., 2006).

Slack resources

Another main limitation to exploratory activities is found in the allocation of human resources. In the current setting some employees are appointed to too many projects. On the other hand not enough employees are allocated to activities that are associated with innovation. This research shows that the allocation of one, or a low number of employees, results in two disadvantageous situations: a localized allocation of knowledge is created, resulting on a dependence on individuals, and systematic understaffing leads to work overloads which cause delays. The underlying cause may be a combination of low enacted support for innovation (West, 1990) or the shortage of slack resources which is a constraint for exploration and innovation in general (Jansen et al., 2006; Nohria & Gulati, 1996; Voss et al., 2008).

5.3 Eliminating the obstacles to exploration

The obstacles to exploratory activities can be assessed by comparing the determined obstacles to solutions that are provided by literature studies. The specific solutions for Electro B.V. concern the organizational climate in which a vision and risk orientation must be developed, the R&D structure and the stimulation of exploration through idea development. Table 5.3 links the solutions to the obstacles.

The final research question to be answered is:

- *How can the obstacles to radical innovation be eliminated?*

Table 5.3 Solutions to the obstacles to exploration.

Topic	Characterization	Solution
Risk orientation	Risk averse climate	• Develop and communicate risk orientation • Show changes towards higher risk orientation
Vision	Lack of vision	Develop vision which: • focuses on R&D activities • separates between exploration and exploitation objectives
Competency trap	R&D focused on exploitation and existing technologies	Look abroad through idea management
Organizational structure	• Entanglement of exploration and exploitation • Lack of resource allocation for exploration	Separate through: • Project characterizations • Resource allocation
Slack resources	• Low support for exploration • Occupied resource base	Separate budget for exploration

Risk orientation

In both exploration and climate literature, risk-taking is regarded as positive for exploration (Levinthal & March; March, 1991; Nystrom, 2002). At this moment, the projects in PROLaunch support and stimulate only low risks. A first improvement towards a climate that enhances exploration is to increase the level of risk-taking and to specify the risks. To achieve this, first the risk orientation at managerial level must be made uniform. Then this unanimous risk orientation must be communicated to the operational level. The formulation of specific boundaries for risks that can or can not be taken accounts for an effective application of a risk orientation (Ahmed, 1998).

At this moment the risk perceptions of the different employee levels in Electro B.V.'s R&D department do not match, but in general a higher risk orientation can stimulate exploratory activities. It is hard to directly change the risk perception at the operational level since it is very likely that the management influences the risk perception at operational level. The increase of the risk perception at the operational level can be accomplished with enacted support by management for high-risk activities. It should be done by first consciously starting projects with moderate or high risk, and then showing the employees the shift in the portfolio of risk classifications.

Vision

The second profound stimulation for the climate for innovation would be to create a shared vision, which is found in leadership and climate literature on innovation (Jansen et al., 2008; Sarros et al., 2008; West, 1990). According to West (1990) a vision must be received with a high degree of clarity, visionary nature, attainability and sharedness. A shared vision has several indirect beneficial effects since it takes away confusion at the managerial level about desires about the future. A vision can approve the activities employees are involved in, but also cause a shift from undesired towards aspired activities. This shift can occur from exploitative to exploratory activities, but also vice versa, depending on the vision and the actual balance between exploration and exploitation. It should not only include statements about innovation, but it should also clarify what activities are not to be spent on innovation. It enables to clarify which activities need short term results and which activities are executed in order to secure results in the long term.

The transfer of the vision to all employees is also important. Sarros et al. (2008) found that transformational leadership is effective for transmitting a vision. Employees are not supported with visionary statements that are stored in executives' offices or in a folder on a network drive. A vision might be communicated through the monthly presentations of the R&D manager to all R&D employees, but such topic may not be dynamic enough to fascinate the employees each time. Highlighting a vision in a presentation is a small contribution to vision transfer, but an optimal vision transfer is best accomplished by frequent, easy accessible and recent information about the vision.

In addition, the elaboration on the motivation for the goal setting or even the motivation for the project itself can increase the attainability of a vision within projects. The unclear arguments about the reasons for setting high targets have been a cause for a low perceived attainability. Therefore, in general, instead of merely posting decisions, an increase of the argumentation for decisions is beneficial for the organizational climate.

When looking at Electro B.V., this research shows that during the data collection period, the absence of a strategy and vision was a cause for confusion and ignorance about the way people should act. Therefore, the recommendation to develop a vision is obvious. The absence of a clear vision can be explained since one month before the start of this thesis a European divisional reorganization has taken place, which had direct consequences for the R&D department. In addition, a new R&D manager was appointed. During the first months of this thesis, other urgent matters may have been more important than to 'develop a vision', but after a few months it certainly was expected by employees. At that point, innovation was mentioned as an important aspect of the R&D department, but innovation was not further clarified than by mentioning some key words like autonomy, risk taking, support, creativity and several other words.

Actually, during the last eight months the development of a vision was executed quite extensively from some key words at the end of 2009 to literally a “Strategic vision for ES EMEA” in March 2010 (Binnendijk, 2010). The contents of the strategic vision are still quite general about ‘how to do business’ and they apply for more than the R&D department only. At this moment important objectives are “driving growth expectations” and “achieving operational excellence” (Binnendijk, 2010). This is a typical form of articulated support for exploitation. In order to articulate more exploratory support, at least one objective for exploration should be added to the ‘strategic vision’. An example can be “developing technologies for future products”. Such objective would really contribute to the expression of a vision for exploration. On the other hand, all objectives must match with the strategy of higher level executives who are responsible for the whole Electro B.V. plant.

The vision should also be more focused on the R&D activities within Electro B.V. in Hengelo instead of the generic goals of EMEA. A clear vision tells employees when they are expected to behave exploratory or when they should pursue exploitation. In the vision statements can be made like: “Innovation is found in technology projects on the subjects: …” and “Growth and cost-out must be achieved through projects on the Product 2”. The most important aspect is to set goals which make sense to the R&D employees.

Idea management

The competency trap has resulted in a short-sighted way of working. Exploratory activities can be stimulated with an idea management system. Such system provides clarity about what happens if someone has an idea for a new innovation. It can take away the passiveness regarding exploration since it enables employees to process ideas to a next stage or to dismiss ideas. The promotion of valuable ideas may be stimulated additionally by rewarding good ideas and providing a safety-net for failures (Levinthal & March, 1993). The idea generation can be combined with any other activities since it should not take much time. When an interesting idea is chosen, resources should be allocated. This implies that a structural allocation of resources for idea development is needed.

In the last years several theses at Electro B.V. have acknowledged and recommended that an idea management process is necessary at Electro B.V. (Van Binsbergen, 2008; Ten Hooven, 2008; Zaadnoordijk, 2009). Now, in 2010, idea management still is not implemented. I could again simply recommend starting with idea management, but that may not be effective. Therefore, I feel the need to lower the level of the recommendations from a conceptual recommendation for idea management towards the development of simple tools that can actually serve as a first initiation towards idea management.

By actually using tangible tools for idea management, the organizational climate will change. In practice, idea management or any process can not be copied from text books since they are abstract processes. Normally, all processes evolve through time into firm-specific routines, influenced by theoretical insights (Tidd et al., 2005). Inputs for a custom idea management process may originate from theory, but they can also be extracted from Electro Corporation’s formal processes like the Corporate Innovation Process and Prelaunch.

Formal processes have been developed within Electro Corporation. These processes are not focused on idea selection, but rather on the single idea trajectory. Besides the PROLaunch process, Electro knows a PreLaunch process that is applied at the Innovation Centers in the United States. It has three phases: identification, verification and commercialization justification, of which the latter overlaps with the first phase in PROLaunch. In the Innovation Centers the PreLaunch tool is used as a surrogate for PROLaunch. Therefore, Prelaunch is too big for implementing it at Electro B.V..

The PreLaunch process is preceded by Electro’s Corporate Innovation Process (CIP), which consists of four phases: commitment (with resources), market sensing (customers), innovation (fill the needs), and confirmation (of the value proposition). The CIP is rather customer focused and does not say how innovations should be acquired. The last two phases overlap with the first part of PreLaunch. The overlap of the three processes is visualized in Appendix C.

Electro's CIP and PreLaunch are quite complex with a high formalization. Therefore a more simple and custom made process is more desirable. The Electro processes show similarities to Wheelwright and Clark's (1992) models for idea development. Due to their simple forms one of those models could be used.

The selection and development of ideas is often visualized with an idea funnel. Wheelwright and Clark (1992) have developed three models for a development funnel. The first is for large R&D departments, the second for small entrepreneurial firms, and the third is a combination of the previous two with the advantages of both models incorporated. Figure 5.1 shows model III, which I think is most appropriate for the R&D department of Electro B.V.

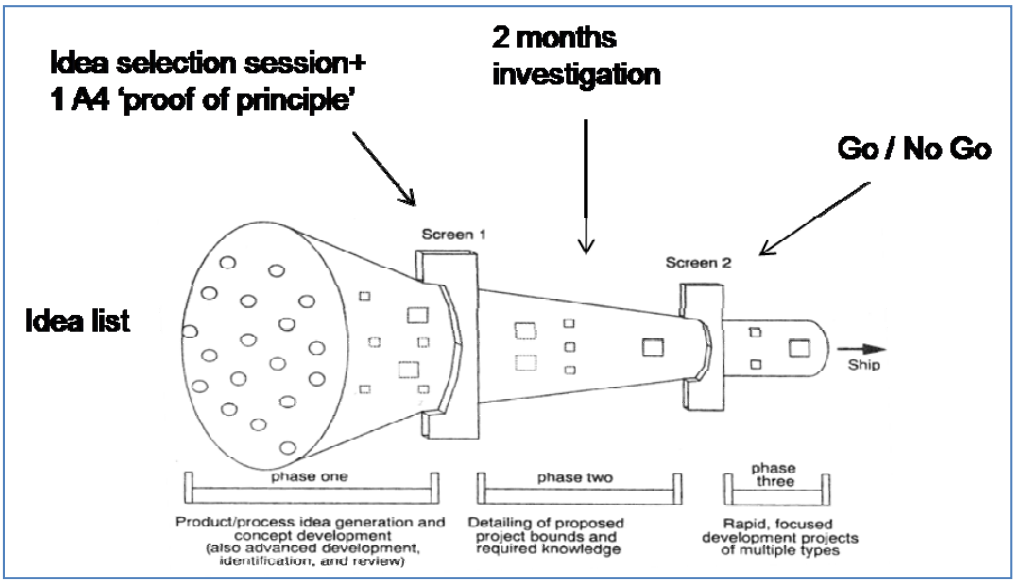

Figure 5.1 The development funnel of model III by Wheelwright & Clark can be used to start with idea management. Adapted from "Revolutionizing Product Development", by S.C. Wheelwright and K.B. Clark, 1992, New York: Free Press, p.124.

A typical characteristic of the idea funnel is a large number of initial ideas with a selection of ideas by mid-management at screen 1. Screen 1 is not a go/no go decision, but rather an assessment about the critical knowledge that is needed and about the congruence of the idea with respect to the current strategy. In practice, screen 1 can be represented by 'ideation sessions' in which a limited number of ideas is selected for further investigation. For the selection of ideas, a small form of one page with a 'proof of principle' can provide sufficient information. In such ideation sessions, ideas with shared topics can be discussed with several stakeholders from the R&D department, including engineers and project managers. The middle management team can control this selection.

Phase two takes only two months where the project's boundaries are determined and the critical knowledge is obtained. This implies that after screen 1, for the first time resources must be allocated to an idea. After the two months a go/no go decision is made at screen 2. In the theoretical model at the end of the process a new product is developed, thus at screen 2 a senior management team decides whether or not to continue. A firm specific routine of Electro B.V. may deviate from this in the sense that in the case of technology projects, no product is directly developed or that another 2 months of investigation can be dedicated to the project. The approval for continuation can still be granted by middle management.

After two months of exploratory research a strict go/no go decision must be made. If the idea shows to be interesting enough to pursue, it can immediately be planned into a 'normal' project. This would be a

good moment to reward an employee, or a small group, for proposing a good idea. Awarding at the moment an idea shows to be actually interesting for the company, is better than rewarding for every idea, since such system would lead to a lot of ideas with poor quality.

NPD and cost-out projects can enter PROLaunch, but technology projects should be managed in a more 'loose' way, with recurring cycles of technology development and adjustment. If no resources are available directly, the status of the idea can be changed to 'queued'. The number of projects that originate from this idea process is dependent on the available resources and the portfolio management, but implementing idea management provides and stimulates exploratory activities.

Without the use of a project manager and PROLaunch in the idea management process, the need is created for some other form of reporting and decision making. I think that especially in technology projects the frequency, but also the nature of reporting should be adaptive. For example, some engineers prefer to write a small report, or to prepare a presentation, others may prefer a discussion within a kind of review meeting. Regarding the frequency of reporting this should be between monthly and quarterly briefings. Note that in this stage of reporting the technology project is not in a preliminary phase in which more frequent assessments are required. Which form of communication is chosen can depend on each reporting event. I think that the engineering managers can play a role in gathering information about the proceedings.

To summarize, the steps in the idea management process could look like this:

- Idea generation
- Select idea's by means of 'ideation sessions'
- Obtain 'proof of principles' of selected ideas
- Select idea's and create resources for two months of investigation
- After two months: decide to continue or stop
- When continuing: appoint resources to either the technology, development, or cost-out project.

Tools

In accordance to the phases and screens of Wheelwright and Clark's model, I suggest several simple tools can be used for idea management. The first one is a simple hard copy idea list. The list provides clarity and acts as a communication tool between the management level and the operational level. Ideas posted on the list may trigger informal discussions, which may stimulate the creativity. The list serves as an idea gathering tool that resembles the first phase of the funnel model. It also shows the devotion of the management towards innovation emerging from the operational level. This list, or multiple copies of it, can be put clearly visible on a wall in the R&D department. The list should not only provide information about the current ideas that are pending, but also provide empty space in which all employees or managers can fill in a new idea. These ideas may about new technology projects, but also about general product development or cost-out projects. If the barrier to post ideas directly on the list appears to be too high, ideas may be suggested to the engineering managers who can add the idea to the list. By posting ideas individually or with a small group, all ideas have one or more 'owners'. This facilitates rewarding good ideas, for example in the case when an idea is 'promoted' into a project.

An example of how the idea list could look like is provided in Appendix D. In this prototype list to each topic an area, owner, and status is assigned. The area might be specified into technology, product development, and cost-out. The status of an idea may be submitted, accepted/denied for exploration, or stopped/continued in project. This list is not complete regarding the technological topics, but adaptation is also possible regarding the characteristics of the list. In time, the nature of the idea list can change. In such way it can evolve into a specific tool for the department.

In order to argue the allocation of resources to an idea, more information is necessary. Therefore, the idea owner may be asked to provide a short 'proof of principle' of the idea. This should not exceed the

length of one page, but the content must be shaped. A form with questions regarding several topics can support the uniformity of decision making. It is not easy to find a default form in literature or on the internet. Therefore a new template should be developed. Examples of topics that could be included address:

- A description of the idea
- The added value of the idea
- The knowledge needed for development
- An argumentation for resources
- An estimation of monetary resources
- An estimation of human resources
- External resources

Organizational structure and slack

A solution must be found to separate exploratory activities from exploitative activities. In a climate in which employees have to decide within their daily activities to spend time on exploratory or exploitative activities, exploitation will prevail. A clear structure can enhance the separation of exploration and exploitation (Ahmed, 1998; McLaughlin et al., 2005; Sarros et al., 2008). In such structure the organizational slack must be concisely allocated and it could be used for exploration.

It must be clear for the employees when and in which setting they should execute exploratory activities. Several options are possible like having all employees to spend 15 % of their time on 'innovative activities' or allocating a certain number of employees fulltime to exploration and the remaining employees to exploitation. Another possibility is to divide the resources project-wise. The R&D employees can than participate in one or more projects, but each project has a typical characteristic. As a result employees will participate in exploratory projects, exploitative projects, or a combination of both types.

This research has shown that it is not wise to provide each employee with 15% time to spend freely, since it may be diminished quickly by the other 'daily' activities. One can only afford such setup when the organization has much slack. Within Electro B.V. this is not the case. Therefore, for structuring exploratory activities it would be better to execute exploration project-wise. Slack resources can than be managed better. The re-establishment of the technology projects is an action that provides a location for exploratory activities and it is a sign about a (new) vision. This implies that an adaptation in the R&D project portfolio management is needed. During this thesis in another study to portfolio management within Electro B.V. is suggested that the use of 'strategic buckets' is appropriate for dividing the budget, but also the activities of the R&D department (Cooper, Edgett & Kleinschmidt, 1997; Zaadnoordijk, 2010).

At this moment, the only distinction between R&D activities made is between 'product development', 'cost-out' and 'standardization'. The addition of a strategic bucket for innovation enhances the separation of different activities.

All R&D projects are executed in the PROLaunch process and therefore they are focused on exploitative product developments, rather than exploratory developments. It is important not to treat innovation projects as regular product development projects because not all innovation projects may result in a new product. Therefore they should be executed separately from the product orientated PROLaunch process.

The team composition of innovation projects is important as well. From the Product 1 project can be learned that a single engineer on a project is not the optimal case. A dilemma is created by the acknowledgement that employees should be dedicated to a single topic, but also that the activities should not be localized at individuals. This implies that to each topic several dedicated employees should be assigned, but that solution would have a large impact on the total amount of available

resources. In order not to ‘lose’ too much fulltime resources to exploratory activities, they may be executed in a time-paced manner in which employees sequentially participate in exploratory and exploitative projects. It would be better to lower the number of (technology) projects, in order to staff them properly and increase the effectiveness of the projects. In general, while scheduling the human resources there must be accounted for unexpected instant needs for human resources. The full scheduling of all resources bears the risk of delays.

6 Conclusions and Recommendations

The first part of this chapter concludes on the contribution of this research to the academic literature and the managerial implications that can be derived. Suggestions for future research and the limitations of this research are formulated. Finally, a personal reflection is provided.

6.1 Research contribution

The answer to the central question is the final conclusion that can be extracted from this research. The research questions have assessed separate aspects of the research objectives. This last paragraph provides statements about the improvement of the climate for innovation.

Findings

What changes concerning organizational climate should be made within the R&D department of Electro B.V. in order to execute more exploratory activities?

This case study research shows that exploratory activities can be stimulated by changing the organizational climate, but also by changing the organizational structure and processes. In this case the most apparent aspect for improving the climate for innovation directly is the development and expression of a vision and an increase of risk-taking. Clearly articulated support for exploratory activities and also the corresponding enacted support in resources, which are time, people and money, contribute to the climate.

Support by means of resources also implies a change in the organizational structure. This is, in order to allocate resources specifically to exploratory activities these activities must be consciously localized. Structural changes that improve the climate for innovation are besides the specific allocation of resources to exploratory activities, also the establishment of an idea management process. The combination of both types of change will be most effective.

Contribution

This study contributes to the examination of the limiting and enabling factors of the organizational climate on exploratory activities. In literature on exploration and exploitation and their combination in organizational ambidexterity, the effects of the organizational climate are only partly considered. For example, Gibson and Birkinshaw (2004) have highlighted climate as one of the aspects of the organizational context. Related to climate, O'Reilly and Tushman (2004) proposed a "strong culture" in order to achieve structural ambidexterity.

Other studies that do consider the organizational climate in-depth with respect to innovation have not discussed the effects of climate on pursuing exploration. In these studies the direct or indirect relationships between climate and innovation are determined (Nystrom et al., 2002; Scott & Bruce, 1994; West, 1990). Only incidentally a distinction between radical and incremental innovation is made, but the organizational arrangement for stimulating exploration in an exploitation orientated organization was not investigated (McLaughlin, 2005; Nystrom et al., 2002).

In this study the absence of exploratory activities has pushed the research approach into a research setting in which exploration must be stimulated. By means of an in-depth case study investigation on the obstacles to exploration this research has explored the specific effects of organizational climate on exploration. As a result, dimensions common in both exploration and climate literature are found as obstacles to exploration. Examples of the shared obstacles are a low risk orientation, the rate of empowerment, an achievement orientation and the effects of organizational structure on exploration.

Regarding the climate dimensions, obstacles are found in leadership activities like sharing a vision and setting clear objectives.

The investigation of the literature foundations of exploration and the organizational climate has shown that in exploration literature the role of climate is minor. In climate literature on innovation the role of the organizational climate is determined as direct, mediating and moderating. Due to the nature of this research the results of this thesis can not be conclusive about the role of climate on exploration. Still, the results from this thesis imply that the organizational climate directly affects the extent to which exploratory activities are executed. But before the climate can actually influence these activities, some conditions must be met in order to change the climate effectively. The most important condition is found in the organizational structure, which in this case would be the allocation of resources. As a result a moderating role, visualized in figure 6.1, should be ascribed to the organizational climate, moderating the relationship between structural antecedents and exploratory activities.

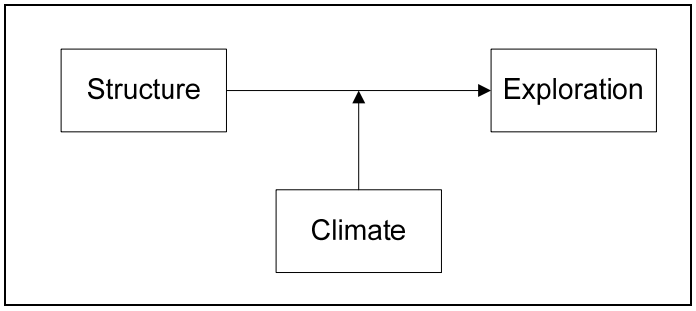

Figure 6.1 The proposed relationship between organizational structure, climate and exploration

6.2 Recommendations for future research

This study has made a start in the contribution to theories about the effects of the organizational climate on exploration. In order to gain more knowledge about the specific relationships between the dimensions of organizational climate and exploration, future research should focus on theory development and the testing of theoretical relationships. Resulting from this report, empirical investigations should consider dimensions like vision, support, involvement, and leadership style on both exploration and exploitation.

First, from all existing literature streams, climate aspects are specially a point of interest in research angles focusing on contextual ambidexterity. The organizational context has similarities to the organizational climate, culture, and the structural context, but the climate is not solely assessed in contextual ambidexterity (Gibson & Birkinshaw, 2004). In addition, in contextual ambidexterity, culture and climate are stimulated with “strong leadership” (Adler et al., 1999). The actual attributes of leadership may be fundamental for the climate which creates an organizational context for ambidexterity. In leadership-based ambidexterity climate dimensions like vision for example, have been determined as attributes to leadership style (Jansen et al., 2008). Therefore, in future research on a climate for exploration the role of leadership should be investigated.

Second, future research could investigate the nature of the relationship between organizational climate and exploration in more detail. Even in general studies on the effect of climate on innovation no consensus has been reached whether the relations are best described by direct, moderation or mediating relationships (Ahmed, 1998; Nystrom et al., 2002; Scott & Bruce, 1994; West, 1990). A mediating role is not likely since the organizational climate is regarded as a surface manifestation of the behaviors of employees (Scott & Bruce, 1994). These behaviors directly affect decisions about whether or not employees execute exploratory activities. As this study implies, a moderating effect of

the climate between organizational structure and the rate of exploratory activities should be investigated. It is not likely that the organizational climate alone is enough to stimulate exploration, but given a certain organizational structure, the climate can affect the effectiveness of the organizational structure positively or negatively. The moderating relationship was visualized in figure 2.3 (b).

Third, with respect to theory testing more empirical and long-term investigations are necessary. A longitudinal study can render insights about how an organizational climate changes over time and whether changes to the climate actually shift the balance between exploration and exploitation. Besides the length of the investigations, the diversity of analyzed companies should be increased. This case study focused on a relative small R&D department in a rather large company in a technological, but stable environment. By investigating the effect of climate on exploratory activities at other companies, the generalization of the findings can be enhanced. In order to stimulate standardization of the research on climate and exploration, specific measures for climate dimensions should be applied or developed. The dimensions determined in this thesis can be a basis for a decent dimension set for analyzing the climate with respect to exploration.

6.3 Research limitations

The case study design has some characteristics which have been an advantage for this research, but the case research design has some setbacks as well. First, case studies present results in a descriptive, qualitative manner. Thus the interpretation of the results is done in a subjective way. It bears the risk that in ranking the observed effects, some aspects are emphasized, which actually may have a minor contribution. Due to the qualitative nature, causal explanations must be made with caution since qualitative studies reduce the uncertainty about causation, but they do not prove theoretical relationships. Therefore, no hard statements about the relationship between organizational climate, exploration and ambidexterity can be made. Still, the qualitative interpretation of the results allows for an inductive way of assessing the results and therefore to suggest theoretical relationships. The triangulation of the findings from different data sources enhances the internal validity, making the research most relevant for the investigated company.

A second shortcoming of this thesis does not consider the nature of the methodology, but rather the contents of the research activities. The data sources could have been better regarding their purpose: exploring the way exploration is done. Initially, the goal was to investigate successful and unsuccessful exploratory projects which had been through an extensive development process. It turned out the exploratory projects were scarce. The choice of the projects to analyze was limited due to a lack of experience with exploration within Electro B.V. the one hand, and due to the specifications for suitable projects on the other hand. This theoretical selection is common for case studies (Eisenhardt, 1989), but in this research the range to select from was narrow. One finalized exploratory project was selected, and one current project was selected which was intended to be exploratory. The lack of clear exploratory projects may be a cause for less robust results Therefore, it is hard to generalize the results of this study and for theory development more research is needed.

6.4 Managerial implications

For the management practices focusing on innovation within Electro B.V., several implications can be deducted in order to manage exploratory and exploitative activities more successful in the future. The implications are deducted from the current situation, aiming at a desired situation. For that situation several actions are needed.

If the management decides that in a desired situation both exploratory and exploitative activities must be executed, the organizational climate and the organizational structure must be adapted. In the desired situation a climate is present in which employees understand whether they have exploratory

tasks, exploitative tasks, or a combination of both. Especially when employees must combine both types of activities, a clear structure is necessary which enables them to divide their spendable time. This implies a conscious allocation of time, money, and employees to both exploration and exploitation.

Actions that should be taken are the clear communication about the desired situation. Focusing on results, output and turnovers is not beneficial for the stimulation of exploratory activities. It is better to state in which kind of activities the taken risks are high and where the risk must be minimized. In addition, management must guarantee that failures, due to a high risk, are not punished and good innovative ideas can be rewarded. For these measures to work, a structure must be assembled which supports exploratory activities and effective idea management. In order to preserve a climate for exploration and exploitation, the communication of a vision should be systematically repeated. If not repeated, the climate may shift back to a climate of exploitation.

6.5 Personal reflection

I think that the start of my thesis was very effective. Due to the courses and assignments of the 'masterclass' course I was able to write a good research plan which contained an introduction, a small theoretical foundation and a preliminary methodology chapter. It really helped me with defining the problem and a suitable research approach.

When looking back, one point of consideration is the efforts I have made on the theoretical chapter during the first period of my thesis. Exploratory case research means that in the beginning of the research the conceptual and operational boundaries are not yet specified in order not to rule out important aspects. Therefore, in the first months of this thesis I did not spend much time in formulating the theoretical aspects. I read a lot of articles though, but I also started early with the data collection. As a result I experienced quite some difficulties in the final months of my research in which I had to finish the theoretical aspects and the analysis consecutive. It was hard to connect those two parts and also account for the results from the data. As a result, I faced a delay of approximately one month.

I also experienced that fulfilling both academic and managerial objectives, results to a lower level of the final result than when focusing on either academic or managerial objectives. This is since efforts in finding firm-specific problems and solutions compete for purely academic findings. Too much firm-specific results are not valuable for an academic view since it makes the results hard to generalize. On the other hand, the company may question whether general results are of any value to the company. As a result, concessions have to be made at both sides which results in a lower quality of the work than when focusing on only one type of objective.

With respect to the academic contribution I found that combining two separate literature streams is quite a challenge. In most studies in literature, the dimensions and theoretical relationships are more specified which simplifies the analysis and the position of the study within a literature stream. Due to the focus on exploration and organizational climate, no broad literature base on this specific combination was available. The application of similar dimensions in both literature streams, but also within one literature stream, leads to confusion about which dimensions to use.

Regarding the empirical aspects of this research I must acknowledge that the way in which the projects for analysis were chosen could have been better. The quick decision in selecting the projects for analysis has led to clarity about what to do, but after all, this selection may not have been optimal. If I would do it again I would take more time and talk to more people than only several employees of the management team.

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8 Appendix

A Questionnaire Innovation scan

Competency/dimension	**Item**
Innovation Performance	
Strategy	
Proactiveness	Typerend voor ons bedrijf is dat wij acties initiëren waarop de concurrentie reageert
	Ons bedrijf is vaak de eerste die innovaties introduceert
	Wat betreft de introductie van nieuwe producten of ideeën heeft onze directie de neiging om de marktleider te zijn
Innovativeness	Over het algemeen legt de directie een sterke nadruk op O&O, technisch leiderschap en innovatie
	Ons bedrijf heeft de afgelopen 5 jaar heel veel innovaties op de markt gezet
	In ons bedrijf zijn veranderingen in productlijnen of dienstensoorten meestal erg ingrijpend
Risk-taking	Ons bedrijf heeft de voorkeur voor risicovolle projecten (met de kans op hoge opbrengsten)
	Vanwege de omgeving waarin wij opereren zijn er ingrijpende en risicovolle acties nodig om de doelstellingen van ons bedrijf te halen.
	In onzekere situaties zetten wij alles op alles om er zeker van te zijn dat we kansen benutten
Competitive	Ons bedrijf heeft ook als doelstelling (impliciet of expliciet) om de concurrentie hard aan te pakken
agressiveness	In vergelijking met onze concurrenten is ons bedrijf uiterst agressief en intens competitief
Success measures	Onze innovatieprojecten zijn meestal succesvol
	Vergeleken met onze concurrenten is onze doorlooptijd van productontwikkeling korter
	Vergeleken met onze concurrenten is de kwaliteit van onze nieuwe producten hoger
	Onze innovatieprojecten worden doorgaans op tijd en binnen budget afgerond
Organization of innovation	
Environment	
Instability	Onze organisatie moet vaak van aanpak veranderen.
	De snelheid waarmee producten in de sector verouderen is hoog
	Acties van concurrenten zijn niet voorspelbaar
	De vraag naar onze producten en consumentenwensen zijn onvoorspelbaar
	De productietechnologie is aan veel verandering onderhevig
Differentiation	De aard van competitie verschilt van product tot product
	De vereiste productiemethode verschilt van product tot product
	Het koopgedrag van klanten verschilt van product tot product
Exploration & Exploitation	
Exploration	Introduceren van een nieuwe generatie van producten
	Het ontsluiten van nieuwe markten
	Uitbreiden van het bestaande productgamma

	Het betreden van nieuwe technologische domeinen
Exploitation	Het reduceren van de productiekosten
	Het verbeteren van het rendement van materiaalverbruik
	Het verbeteren van de bestaande productkwaliteit
	Het verbeteren van de flexibiliteit van het productieproces
Innovation Proces	
Search	Wij hebben een strategisch beleid gericht op het zoeken naar relevante technologieën
	Wij zijn ons bewust van relevante technologische ontwikkelingen in onze eigen markt
	Wij zijn ons bewust van relevante technologische ontwikkelingen in aanverwante industrieën
	Wij zijn ons bewust van relevante technologische ontwikkelingen bij universiteiten en overige kennisinstellingen
	We zijn actief bezig met het verkennen van de toekomst, daarbij gebruikmakend van technieken als scenario's
	We hebben signaleringssystemen waarmee we vroegtijdig nieuwe trends inbrengen in ons strategische besluitvormingsproces
	We zoeken naar signalen die zich bevinden aan de rand van ons bedrijf, …
	… bijvoorbeeld bij dochterondernemingen, joint ventures en leveranciers
Selection	Specifieke innovatie doelstellingen zijn opgenomen in de strategie van de organisatie
	Lange termijn planning van 2 of meer generaties producten
	Medewerkers in ons gehele bedrijf onderkennen het belang om consistent vast te houden aan het strategische beleid
	Projecten worden systematisch gerangschikt op basis van de potentie voor het bedrijf
	Voortdurend monitoren van kans op succes van projecten
Implementation	Sterke verbinding en communicatie tussen productie en O&O
	Voor elke innovatieproject wordt er een projectleider aangesteld
	Gebruik van multidisciplinaire teams waarbij meerdere functies en afdelingen betrokken zijn bij productontwikkeling
	Het ontwikkelen van een marketingplan is een integraal onderdeel van productontwikkeling
Formalization	Voor elk innovatieproject bestaat er een formeel proces waarbij verschillende fases zijn gedefinieerd
	Voor elk innovatieproject is er een duidelijk en gedocumenteerd proces
	Go/NoGo criteria zijn helder en zijn vooraf gedefinieerd voor elk evaluatiemoment binnen een innovatieproject
	Productontwikkelingsprocessen worden formeel gedocumenteerd
Evaluation	Elk individueel innovatieproject wordt geëvalueerd op basis van standaard criteria
	Voor elk innovatieproject worden er meerdere evaluatiemomenten ingelast.
	Elk innovatieproject wordt door verschillende personen geëvalueerd
	Er is een specifieke groep belast met de taak van evaluatie van innovatieprojecten
	Een software tool voor evaluatie van innovatieprojecten is in gebruik
	Resultaten van de evaluatie van innovatieprojecten worden bijgehouden en opgeslagen
	Resultaten van de evaluatie van innovatieprojecten zijn eenvoudig toegankelijk binnen de organisatie
Learning	We benchmarken onze innovatieprojectprestaties met de beste in onze sector
	Het verbeteren van het proces voor productontwikkeling is de verantwoordelijkheid van alle projectteams

	Het verbeteren van het proces voor productontwikkeling gebeurt door het verspreiden van leerervaringen onder projectteams
	Leren over productontwikkeling gebeurt door uitwisseling van procesdata en analyses van andere innovatieprojecten
	We proberen te voorkomen dat problemen, die zich in eerdere innovatieprojecten hebben gemanifesteerd, zich opnieuw voordoen
	We zijn goed in het vastleggen van wat we hebben geleerd zodat anderen in de organisatie er gebruik van kunnen maken
HRM	
Human capital	Onze werknemers bezitten kennis, vaardigheden, en attitudes die … beschouwd worden als de beste in de sector
	ons onderscheiden van de concurrentie
	moeilijk te imiteren zijn door onze concurrenten
	moeilijk vervangbaar zijn
	bijdragen tot het verbeteren en/of vernieuwen van processen en producten/diensten
	het mogelijk maken om een uitstekende klantenservice te bieden
	bijdragen tot een verhoogde productiviteit binnen ons bedrijf
	het mogelijk maken om in te spelen op nieuwe of veranderende eisen/verwachtingen van de klanten
	kunnen worden gekenmerkt door een ondernemende houding
	leiden tot creativiteit ten behoeve van innovatie
	het mogelijk maken om kansen te benutten
	Bijdragen tot het welslagen van het bedrijf
Innovation oriented HR policies	Het gebruik van creativiteit als selectiecriterium
	Het gebruik van leerpotentieel als selectiecriterium
	Het inroosteren van tijd om te experimenteren of nieuwe ideeën te ontwikkelen
	Het financieel belonen van werknemers die nieuwe ideeën aanbrengen
	Het bewust toekennen van uitdagende opdrachten die de creativiteit en het leervermogen aanscherpen
	Het opleiden in methoden voor het creatief oplossen van problemen
	Het organiseren van groepssessies met het oog op procesverbetering (bv. Brainstorming, verbeterteams, kwaliteitskringen, etc.)
	Het ondersteunen van netwerking met externen (bv. Financieel of door tijd te creëren)
	Het meten van competenties met het oog op bijkomende opleiding en ontwikkeling
	Het gebruik van een systeem van competentiemanagement voor individuele loopbaanplanning
	Het financieel belonen van het verwerven van nieuwe competenties of vaardigheden
Knowledge -	Het registreren en bewaren van de resultaten van interne besprekingen
Management	Het stelselmatig toevoegen van nieuwe kennis (bv. nieuwe oplossingen of technieken) in een databank of inventaris (‘lessen uit het verleden’)
	Het stimuleren van werknemers om actief kennis toe te voegen aan een kennisdatabank of –inventaris
	Het onbeperkt toegang verlenen aan werknemers tot in het verleden opgebouwde kennis (bv. toegang tot inventaris op intranet
	Het bewaren onder één of andere vorm van een inventaris of bestand (‘portfolio’) van de competenties van medewerkers
	Het ondernemen van gerichte acties om het verloop tegen te gaan van werknemers die voor de organisatie waardevolle kennis bezitten
External oriëntation	
Market orientation	
Customer focus	Onze bedrijfsdoelen zijn voornamelijk gericht op klanttevredenheid

	We meten voortdurend de mate waarin onze producten en diensten gecommitteerd zijn aan en georiënteerd zijn op de wensen van de klant
	Onze strategie om concurrentievoordeel te realiseren is gebaseerd op onze kennis over de behoeften van klanten
	Onze bedrijfsstrategieën worden gestuurd door onze overtuigingen over hoe we meerwaarde kunnen bieden aan klanten
	Klanttevredenheid wordt regelmatig en systematisch gemeten
	We schenken veel aandacht aan service na de verkoop
Competitor -	Onze verkoopmedewerkers wisselen regelmatig gegevens uit over de strategieën van concurrenten
orientation	We reageren snel op bedreigende acties van concurrenten
	Het management bespreekt regelmatig de sterke punten en strategieën van concurrenten
	We richten ons op markten waarin we concurrentie- voordelen kunnen behalen
Interfunctional -	In onze organisatie worden zowel positieve als negatieve ervaringen met klanten openlijk met alle afdelingen uitgewisseld
coordination	Alle bedrijfsonderdelen werken intensief samen om aan de behoeften van onze klanten tegemoet te komen
	Al onze managers begrijpen hoe iedereen in ons bedrijf kan bijdragen aan het creëren van waarde voor de klant
	We delen resources met andere business units
Embedded ties (supplier)	
Problem solving	Onze belangrijkste leverancier werkt met ons samen om problemen op te lossen
	We zijn er samen met onze belangrijkste leverancier verantwoordelijk voor om zaken gedaan te krijgen
	We werken samen met onze belangrijkste *leverancier* bij het oplossen van elkaars problemen
Information sharing	Onze belangrijkste *leverancier* waarschuwt ons voor gebeurtenissen die voor ons problemen kunnen veroorzaken
	Onze belangrijkste *leverancier* deelt zijn toekomstplannen met ons
	Onze belangrijkste *leverancier* deelt vertrouwelijke en gevoelige informatie met ons
Trust	Onze belangrijkste *leverancier* onderhandelt met ons op een eerlijke manier
	Onze belangrijkste *leverancier* misleidt ons niet
	Onze belangrijkste *leverancier* houdt zich aan afspraken
Embedded ties (customer)	
Problem solving	Onze belangrijkste *klant* werkt met ons samen om problemen op te lossen
	We zijn er samen met onze belangrijkste klant verantwoordelijk voor om zaken gedaan te krijgen
	We werken samen met onze belangrijkste klant bij het oplossen van elkaars problemen
Information sharing	Onze belangrijkste *klant* waarschuwt ons voor gebeurtenissen die voor ons problemen kunnen veroorzaken
	Onze belangrijkste *klant* deelt zijn toekomstplannen met ons
	Onze belangrijkste *klant* deelt vertrouwelijke en gevoelige informatie met ons
Trust	Onze belangrijkste *klant* onderhandelt met ons op een eerlijke manier
	Onze belangrijkste *klant* misleidt ons niet
	Onze belangrijkste *klant* houdt zich aan afspraken
Controls	
Vicarious learing	Kijkt uw bedrijf naar andere benaderingen die bij andere bedrijven worden

	toegepast?
7 point scale	Krijgt uw bedrijf ideeën over nieuwe manieren van werken van andere bedrijven
	Verbetert uw bedrijf de manier van werken door te kijken wat andere bedrijven doen?
Organizational climate	
Empowerment	Er is ruimte voor werknemers om hun eigen beslissingen te maken
	Werknemers hebben de vrijheid om van de regels af te wijken
	Werknemers hebben de vrijheid om naar eigen inzicht beslissingen door te voeren
	Werknemers beïnvloeden belangrijke werkgerelateerde beslissingen
	Werknemers mogen hun eigen werk plannen
	Werknemers hebben de mogelijkheid om ideeën aan te dragen voordat er een beslissing genomen wordt
Risk orientation	De filosofie van ons management is dat wij op de lange termijn een voorsprong ontwikkelen door langzaam, veilig en op zekerheid te spelen
7 point scale	Ons bedrijf boekt vooruitgang door berekende risico's op het juiste moment te nemen
	In dit bedrijf is de besluitvorming te voorzichtig om maximale effectiviteit te behalen
	Ons management wil best een keer gokken op een goed idee
	Het is noodzakelijk om af en toe een redelijk groot risico te lopen om een voorsprong op de concurrentie te behouden
Achievement -	Het behalen van doelstellingen is erg belangrijk binnen dit bedrijf
orientation	Marktleiderschap is erg belangrijk binnen dit bedrijf
7 point scale	

B Interview questionnaires

Questionnaire Product 1

Algemeen

- Hoe verliep het onderzoek naar mogelijke technologieën nav het concept?
- Hebt u ooit aan kunnen geven dat de powerline technologie niet goed genoeg was? Hoe werd daar op gereageerd?
- Had u meer invloed op de keuze willen hebben?
- Hoe was het om fulltime bezig te zijn met Product 1? Werd er veel gevraagd om ook aan andere projecten te werken?
- Waar haalde u de kennis vandaan voor het ontwikkelen van de modules?
- Is de selectie van het protocol en het PLC principe volgens u op een goede manier gegaan?
- Had u meer invloed op de keuze van het protocol willen hebben?
- Hoe groot was de groep werknemers die Product 1 in 2000 en 2001 op de markt gezet heeft?
- Hadden de mensen die beslisten over de release voldoende kennis?

Inleiding

1. Kunt u wat meer vertellen over uw functie binnen het bedrijf en binnen Product 1?
2. In welke tijdsperiode heeft u deelgenomen aan Product 1?
3. De bedoeling van dit interview, is om meer te weten te komen over de ontwikkeling van innovatie bij Product 1. Zou u eens kunnen toelichten wat het innovatieve van Product 1 was?

Voor 2000 Onderzoeksfase/idee ontwikkeling

4. Wie is op het idee voor Product 1 gekomen?
5. Is het idee tot stand gekomen uit marktbehoeften of uit technologische ontwikkelingen?
6. Zag u vanaf het begin potentieel in het idee? En waarom?
7. Was iedereen binnen de organisatie onmiddellijk enthousiast over het idee? Waarom wel/niet?
8. Heeft Electro de innovatie zelf ontwikkeld, of samen met andere bedrijven? Kunt u eens concreet beschrijven hoe de *samenwerking met de andere bedrijven* verliep?
9. Hoe lang heeft het geduurd voordat er een eerste prototype van het product was?
10. Wat waren de belangrijkste *problemen/uitdagingen* bij het uitwerken van het *originele idee*? Technisch, maar ook *organisatorisch*.
11. Hoe bent u *met* deze *problemen/uitdagingen omgegaan*?
12. Is het originele idee onveranderd gebleven of hebt u toch aanpassingen moeten doorvoeren? Waarom? Kunt u een concreet voorbeeld geven?
13. Zijn er tijdens deze *eerste fase* belangrijke *gebeurtenissen* geweest (binnen of buiten de organisatie) die een grote impact hebben gehad op het innovatieproject?
14. Hoe werd de uitwerking van het originele idee gefinancierd (enkel interne financiële middelen, overheidssteun, andere partners?
15. Zijn er bij het begin van het project momenten geweest waar men overwogen heeft op het project te stoppen? Kunt u hier iets meer over zeggen?

Ontwikkelingsfase tot aan: productie

16. *Hoe* heeft men getracht interesse te krijgen van potentiële klanten voor het nieuwe product?
17. Was het *gemakkelijk* om eerste klanten te vinden of verliep dit proces vrij *moeizaam*?
18. Werden klanten expliciet betrokken bij het ontwikkelingsproces?
19. Was er feedback van klanten?
20. Wat is met de feedback van klanten gedaan? (Niks? Management druk uitgeoefend?)
21. Hoe zijn de veranderingen van het management gegaan?
22. Nadat eerste prototypes van het product klaar waren, werden er op dat moment andere mensen van Electro bij het project betrokken? Wie?
23. Werden er op dat moment externe partijen betrokken in het ontwikkelingsproces? Hoe verliep de samenwerking met deze externe partijen?
24. Zijn er tijdens deze fase *belangrijke gebeurtenissen* geweest (binnen of buiten de organisatie) die een grote impact hebben gehad op het innovatieproject?

In 2004 leidden technische problemen tot een verminderd succes van het product.
Veel tijd werd gespendeerd aan garantie claims.

25. Waar waren de problemen aan te wijten? Te snel naar de markt? Niet genoeg ontwikkeld?
26. Hoe bent u met de problemen omgegaan?
27. Verschil in opvatting tussen management en ingenieurs?

Begin 2002 Productie en verkoop
In 2007 waren de technische problemen verholpen.
28. Werd er in tijden van 'voorspoed' aandacht geschonken aan deze positieve ontwikkelingen, bijvoorbeeld in de vorm van borrels, bonussen of officiële goedkeuring?
29. Wat waren de redenen voor het oplossen van de technische problemen na drie jaar?

Mogelijke samenwerking met Power company N in 2007
30. Wat voor invloed had de samenwerking met Power company N op de sfeer binnen de projectgroep?

Proefproject in Heino met Product 1 en het Elderly Care (Zigbee) systeem.
Product 1 werd gerund als een aparte business.
31. Ging het veranderen naar een SBU gepaard met andere manieren van leiderschap (1) en besluitvorming (2)? Hoe ging dat in zijn werk?
32. Voelde u uzelf een ondernemer of medewerker van (het grote) Electro? Hoe vrij kon u uw gang gaan?

Maar nog steeds geen winst (?)
33. Wat was ongeveer de omzet die behaald is?
34. *Was het mogelijk geweest om (meer) winst te maken als iedereen 'een tandje bij geschakeld' zou hebben?*
35. *Was er genoeg ambitie?*

Eind 2007
Fusie tussen Power company N and Power company E mislukt: minder aandacht naar Product 1 (vanuit Power company N).
36. Waarom heeft het mislukken van een fusie tussen twee andere bedrijven gevolgen voor Electro/Product 1?

Januari-april 2008
Electro neemt de Company M Group over. Company M heeft ook een Domotica systeem vergelijkbaar met Product 1, maar zijn omzet en winst is hoger.

Januari 2008
Peter van Buuren aangesteld als business unit manager
Samenwerking met Power company N wordt beëindigd.
2009
Product 1 wordt stopgezet/verkocht en de aandacht gaat uit naar Company Ms systeem.

37. Zag u de overname van Company M en de bedreiging voor Product 1 niet eerder aankomen?
38. Wat had er moeten gebeuren of wie had iets moeten doen om Product 1 bij Electro Electro Hengelo te waarborgen?
39. Is de overname maar gewoon ondergaan? Was het niet waardevol om Product 1 vast te houden?
40. Wat is er (door u) gedaan om Product 1 te redden? Geanticipeerd? Leiderschap?

Algemeen:
Nederlandse focus van Product 1.
41. Wat waren de eigenschappen van het Product 1 project die u als positief beschouwt?
42. Was er vrijheid ten opzichte van de formele Electro procedures?

Innovatie klimaat:

Ik heb een aantal vragen die betrekking hebben op het innovatie klimaat.

43. Wat vindt u er van?
44. Zijn er vaardigheden van project managers die u mist om iets innovatiefs in goede banen te leiden? Bijvoorbeeld procesmatig, interesse in onbekende technieken, gedrevenheid.
45. Hebt u suggesties om de dagelijkse bezigheden beter te kunnen combineren met innovatieve bezigheden?
46. Is de visie van het management over de toekomst opwindend of saai?
47. Hoe zou Electro volgens u op zoek moeten gaan naar de volgende generatie producten? Of gerelateerde producten met nieuwe markten?
48. Wat zijn volgens u essentiële acties die managers moeten ondernemen wanneer ze succesvol willen innoveren?
49. Hebt u zelf nog opmerkingen, suggesties of vragen?

Questionnaire Product 2 cost-out

Inleiding

De bedoeling van dit interview, is om meer te weten te komen over de ontwikkeling van innovatie binnen Electro. In mijn analyse van innovatieve activiteiten bij R&D heb ik in het begin van mijn onderzoek gekozen om Product 2 cost out als leidraad te nemen. Mocht u een antwoord niet kunnen betrekken op het Product 2 project, dan kunt u ook antwoorden in algemene zin, waar mogelijk.

1. Kunt u wat meer vertellen over uw functie binnen het bedrijf en binnen Product 2 cost out?

Projectaanleiding

2. Wat weet u van de voorgaande versies van Product 2 cost out?
3. Wanneer hoorde u voor het eerst dat dit project er aan zat te komen?
4. Can you match the priority of the project with the effort that is put into the project?
5. Waarom worden eerst add-ons afgemaakt en daarna cost out? Logische keuze? Add-ons klaar?
6. Was iedereen binnen de organisatie onmiddellijk enthousiast over het idee? Waarom wel/niet?

Opstartfase

7. Zag u vanaf het begin potentieel in het idee? En waarom?
8. Wat is het vastgestelde budget aan kostenreductie en hoeveel procent van de totale kostprijs is dat?
9. Is het originele doel onveranderd gebleven of hebt u toch aanpassingen moeten doorvoeren? Waarom?
10. Was er sprake van een specifiek team dat zich bezighoudt met Product 2 cost out? Hoe ziet dat er uit in de tijd?
11. Op welke manieren is de kostenreductie te behalen?
    Bij welke afdeling zijn de meeste kostenbesparingen mogelijk?
12. In welke richtingen wordt het proces gestuurd vanuit het management?
13. Welke rol speelt technologische innovatie in dit proces?

Technologisch innovatietraject

14. Wat zijn de positieve/negatieve ervaringen met samenwerking met leveranciers?
15. Wat zijn de positieve/negatieve ervaringen van samenwerking met klanten?
16. Wat zijn de ervaringen met samenwerken met kennisorganisaties?
17. Wie zijn er op dit moment belast met het zoeken naar nieuwe technische mogelijkheden?
18. Naar wat voor een soort oplossingen wordt er gezocht bij technische verbeteringen? Denk aan: bekende, kant-en-klare of verwante oplossingen. Aan de andere kant: nieuwe, opkomende technieken?
19. Worden er al testobjecten/prototypes gemaakt? Hoe lang duurt/duurde dat?
20. Wat zijn de belangrijkste *belemmeringen* voor het ontdekken van een *origineel idee*?

21. Zijn er de juiste testfaciliteiten om iets leuks te testen?
22. Hoe bent u met deze uitdagingen omgegaan?
23. Zijn er tijdens deze *eerste fase* belangrijke *gebeurtenissen* geweest (binnen of buiten de organisatie) die een grote impact hebben gehad op het project?
24. Als u het zelf mocht zeggen, op welke manier zou u het liefst onderzoek doen?

Klimaataspecten

25. Welke afdelingen zijn er betrokken bij het project?
26. *Hoe* verloopt de samenwerking met andere afdelingen?
27. In hoeverre worden verantwoordelijkheden gedelegeerd (naar andere afdelingen)?
28. Hoe belangrijk is volgens u het behalen van doelen binnen dit bedrijf?
29. Zijn er vaardigheden van project managers die u mist om iets innovatiefs in goede banen te leiden? Paradigm shift. Bijvoorbeeld procesmatig, interesse in onbekende technieken, gedrevenheid.
30. Zijn er bij R&D mensen die technisch gedreven genoeg zijn om achter nieuwe technologieën aan te gaan? Constructeurs construeren, projectleiders plannen, welke types zijn er nog meer nodig?
31. Worden uw dagelijkse bezigheden gecombineerd met innovatieve bezigheden? Suggesties?
32. Is de visie van het management over de toekomst opwindend of saai?
33. *Hoe* zou Electro volgens u op zoek moeten gaan naar de volgende generatie producten? Of gerelateerde producten met nieuwe markten? Wat zijn essentiële managementacties, die u verwacht?

Terugkoppeling enquête

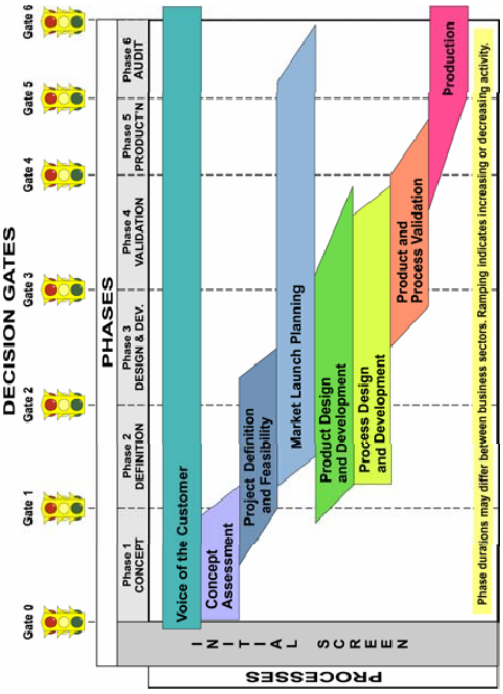
34. Vindt u dat het management een eenduidige visie uitstraalt over de risico's die genomen moeten/mogen worden als het gaat om ingrijpende acties? Wat is die visie dan?
35. In hoeverre is de R&D afdeling bezig met een nieuwe generatie producten, nieuwe markten en technologische domeinen?
36. Hoe wordt er gezocht naar innovatieve ideeën? Zijn daar procedures of hulpmiddelen voor?
37. Hoe gaat de evaluatie van (innovatie) projecten in zijn werk? Wat wordt er mee gedaan?
38. In hoeverre hebben ingenieurs de vrijheid om zelf beslissingen te maken?
39. Is the management unanimous about the possibility to learn from other companies?

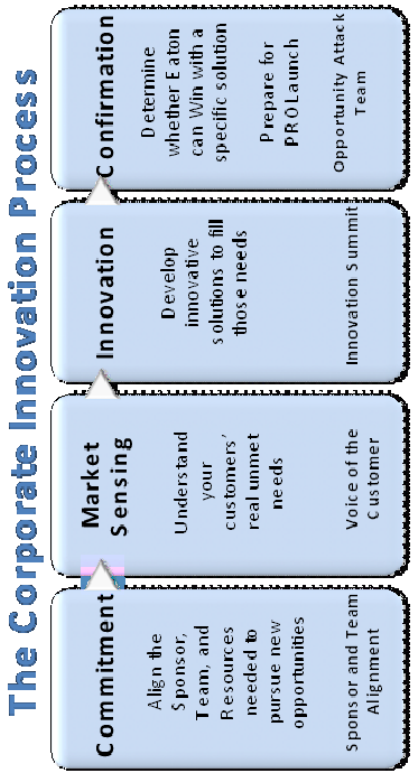
Knowledge management

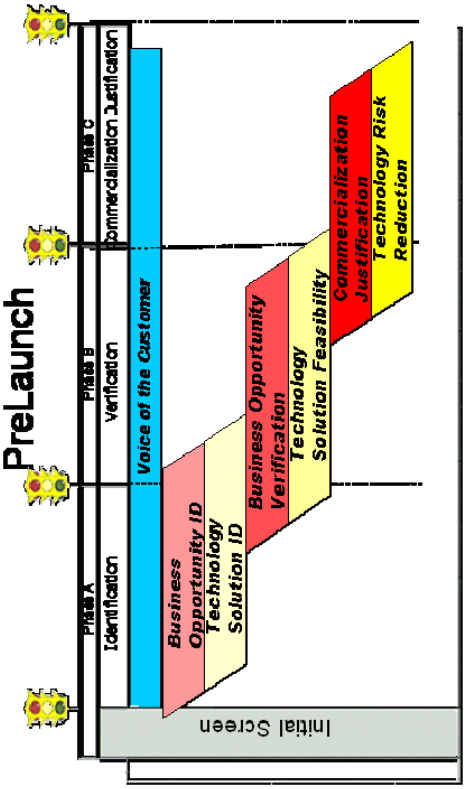
40. Is het voor u duidelijk wat het doel van knowledge management is?
41. Op welke manier wordt het knowledge management programma volgens u op dit moment gebruikt?
42. Hoe zijn de 'technology projecten' vormgegeven in het KM? Vindt u dat de goede manier? Hoe anders?
43. Wat vindt u van de onderwerpen van de technology projecten?
44. Wie bepaalt welke technology onderwerpen er gekozen worden? Mee eens?

45. Hebt u zelf nog opmerkingen, suggesties of vragen?

C Overlap Innovation process, PreLaunch and PROLaunch







The Corporate Innovation Process can overlap PreLaunch phases A or B

D Prototype idea list

R&D idea generation

Topic	**Area (technology/product development/ cost-out)**	**Owner(s)**	**Status**
Internal arc control	product development	Adri Lammers (?)	Project
40 kV	technology	Not available	feasibility study by student
Nano particles for insulation and heat conductivity	technology	Paolo D'Amico	stopped project
Smart Grids: embedded measurements	technology	Yorick Dragt & Elise Morskieft	Preliminary assessment
Solar energy applications			Submitted